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DECEMBER 8, 1941
VOLUME 30, No. 25

AMERICAN DYESTUFF REPORTER

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VOLUME 30 NUMBER 25

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DECEMBER 8, 1941

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INTERSECTIONAL CONTEST

Friday Afternoon, October 31, 1941

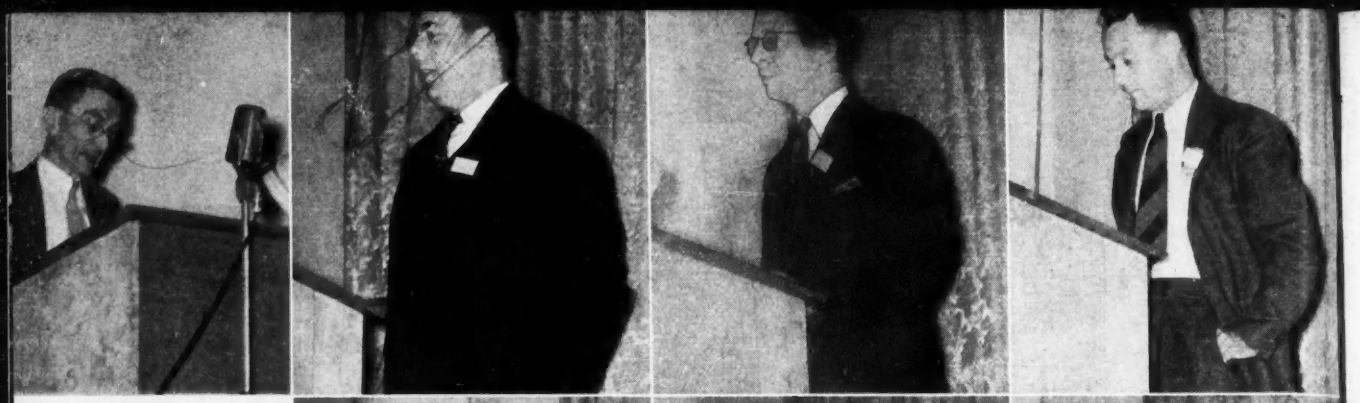
THE Intersectional Contest of the American Association of Textile Chemists and Colorists convened in the Grand Ballroom, The Carolina, Pinehurst, North Carolina, at 2:25 o'clock, Dr. Carl Z. Draves, President, presiding.

Samuel L. Hayes (Chairman, Convention Committee): It is my pleasure to call the meeting to order and, as the representative of the Piedmont Section, to introduce to you the President of our Association, Dr. Carl Z. Draves, who will now take charge of the meeting. Dr. Draves. (Applause.)

President Draves: On behalf of the national organization of the American Association of Textile Chemists and Colorists I want to express the appreciation of the officers and members to the Piedmont Section for bringing us together at what we know is going to be one of the best conventions we have ever held.

We are now about to embark upon the Second Intersectional Contest. The First Intersectional Contest was held last year in New York and was eminently successful. We know that again the competition is keen and that there is a great deal of rivalry going to be shown here. Last year, unfortunately, the conditions of judging were not quite sufficiently well known ahead of time. This year we have anticipated that and I am asking Dr. Olney, who is going to act as the Supreme Court Justice in this matter, to explain to you the rules of the Contest. Dr. Olney. (Applause.)

Dr. Louis A. Olney: I think most of you are acquainted with the procedure which we followed last year in carrying out the Intersectional Contest, but for the few who perhaps may not have been at the meeting last year, I am



Shown here are the speakers in the Intersectional Contest. Top row, left to right, Charles A. Seibert, Philadelphia Section; Dr. Seibert Q. Duntley, Northern New England Section; Andrew J. Kelly, South Central Section; C. Norris Rabold, Piedmont Section; bottom row, left to right, Thomas H. Roberts, Rhode Island Section; P. J. Wood, New York Section; Perrin N. Collier, Southeastern Section.

Photos by Robert W. Philip

going to explain with not too much detail just how it was done.

Last year, in making preparations for the occasion, a number of letters were sent around to the judges and other interested members and one of them included a questionnaire which mentioned nine different qualities which might be possessed by a paper and might be used in judging its value. Of the total number these were finally sifted down to three: general scientific and technical value, originality or record of discovery, and presentation. The Judges were then asked to vote by letter as to how much value they would give to these three and almost without exception they voted the same way and the votes when the results were averaged, were: general scientific and technical value was given a rating of 50 per cent, originality and record of discovery was given a rating of 30 per cent, and presentation, 20 per cent.

The method which will be followed may be of some interest to you. We are going to rate the papers three, two and one. The best paper in the mind of any particular Judge will be given a rating of three. The second best paper will be given a rating of two and the third best a rating of one. The other four papers, of course, will not receive any rating. The Judges will record their decisions on cards of all which are alike and which will be handled to me and I will not know, myself, which Judge handed in any specific card. I shall then proceed to add up these numbers and the Section having the highest number will have the first prize, the second highest will have the second and the third highest number, the third.

Unless there is a tie I will have nothing to do with the final result. But if there is a tie it is understood that I will be the one to cast the deciding vote.

As to the presentation of the papers, these are Sectional papers and supposedly the one who presents the paper need have but little to do with its preparation. On the other hand, there are some papers, perhaps, where the one who did the most work will present the paper and then we may have another paper where one man did most of the work and he will not present the paper at all. So there really is no connection, necessarily, although there may be some, between the one who presents the paper and the one who is responsible for the writing of it. Remember, they are Sectional papers, and the prize is to be awarded to the Section and not to an individual.

Last year it was $50 for the first prize, $30 for the second, and $20 for the third. We believe that that is the best way to proceed this afternoon. I think you can all look forward to an enjoyable and also a profitable afternoon. Thank you.

President Draves: Since this is a contest we must follow the rules. According to the rules which have been published ahead of time, and which all the speakers understand, each speaker is allotted 20 minutes for presentation of his paper and I propose to hold him strictly to that regulation. In 18 minutes I shall tap the table so as to give a warning that in two minutes the presentation of the paper must end.

Further, because the discussion can't necessarily be equal, there will be no discussion of the papers. With that understanding, then, we will begin.

. . . The papers were then presented . . .

Intersectional Contest—

☆ *Winner of Third Prize*

Progress Report on the Process and Utilization of DOMESTIC FLAX[1]

HAROLD BUNGER[2], J. L. TAYLOR[3], and C. A. JONES[4]

State Engineering Experiment Station, Georgia School of Technology, Atlanta, Georgia

Presented by P. N. Collier for the Southeastern Section

ABSTRACT

A systematic study of the adaptability of the flax fiber plant to the soil and climatic conditions of the South and a research program directed towards processing the straw into fiber, yarn and fabric are being conducted. In an effort to create a market for this farm product and to provide the cotton textile industry with domestic flax fiber, the processing of flax straw into a stapled fiber suitable for working on cotton mill equipment and for blending with cotton in textile products has been extensively investigated.

THE work covered by this report has been sponsored by the Tennessee Valley Authority at this institution and at the Georgia Agricultural Experimental Station. Experimental work in the production of flax was begun by the Authority early in its existence. Shortly thereafter a co-ordinated program of research was established in Georgia whereby the agricultural phases of the program were investigated by the Georgia Agricultural Experiment Station, and research into the processing and utilization of the straw and fiber was carried on by the State Engineering Experiment Station.

In a previous paper[5] the objectives of an investigation of the growth, harvesting, processing, and textile utilization of domestic flax were presented. Continued work has afforded additional information which will be presented here. Over two hundred varieties of flax have been tried in various sections of the state of Georgia for developing a market for the farmer for an additional profitable cash crop which also has soil conserving features and to provide an economical source of flax to meet the needs of the cotton textile industry for new fibers and mixed fabrics desired by the public. It has been found from these tests that two varieties, the Cirrus and the Triumph, are best adapted to this locality. A systematic study is now in progress using these two varieties to determine the effect of planting time, soil type, climatic conditions, harvesting time. and other variables on the yield and quality of the final fiber and of by-products.

PROGRESS IN THE PROCESSING OF FLAX INTO FIBER

As mentioned in the previous report[5] the main object of our investigations has been to replace the traditional time-consuming bacteria-retting, manual method of flax processing with a continuous, chemical-retting, mechanical process, obtaining a fiber that may be utilized successfully on cotton machinery.

It is perhaps desirable to review briefly the structure of the flax plant. The flax plant *Linum usitatissimum* is annual in growth and rather delicate in structure. The overall height is about forty inches; the stem is slender and straight. The cross-section[6] of flax-straw reveals from outside in (1) an orderly, linear layer of cuticular cells, (2) an irregular intermediate layer of cortical parenchym, (3) bast fibers in groups, being the flax fibers proper, (4) the random-like cambium layer, (5) the woody tissue, the cells being arranged in an orderly, close-packed arrangement, and (6) a pithy core which becomes hollow as the plant matures. The straw consists of 12 per cent fiber, 24 per cent cortex, and 64 per cent shive. The chemical composition of each layer is shown in the following table[7]:

TABLE 1
Chemical Composition of Flax-straw Components

Chemical constituent	*Cortex*	*Fiber*	*Shive*
Cellulose and hemicellulose	65.0%	72.0%	60-70%
Lignin	....	24.0	20.30
Pectin	20.0	2.5	.....
Wax	10.0	1.0	1.0
Rosin	....	...	1.5
Coloring Matter	5.0	0.5	1.0

It is necessary in any process to separate the shive from the fiber and further to remove completely the lignins and hemicelluloses which are associated or chemically combined with the flax fiber. It is obvious from Table 1 that the chemical composition of shive is not greatly different

[1]Released for publication by G. R. Rosselot, Director, State Engineering Experiment Station.
[2]Late Director of the Flax Project (Deceased Aug. 15, 1941).
[3]Director of the Flax Project.
[4]Director of the A. French Textile School, Georgia School of Technology.

[5]Worthington and Jones, American Dyestuff Reporter *28*, P63 (1939).
[6]Matthews, J. Merritt: *The Textile Fibers*, New York: John Wiley & Sons, Inc. (1924), p. 738.
[7]Caldwell, S.A.G.: *Preparation and Spinning of Flax Fiber*, London: Emmott & Company (1931), p. 7; Oakely, F. I.: *Long Vegetable Fibers*, London: Ernst Benn, Ltd., (1928), p. 43.

from that of the fiber. It follows that any chemical treatment will be necessarily one of degree rather than of kind, and that any treatment affecting the undesirable constituents is likely to affect the cellulose fiber to somewhat the same extent. It is further desirable that enough of the pectins be removed so that the fibers will be dissociated into near ultimate fibers, yet that enough residual pectic matter will be left to aid in slipping during spinning and to give strength and the quality of "feel" to the fiber. Briefly, the problem is to remove the lignins, hemicelluloses, and partially to remove the pectins and waxes without forming weak oxycelluloses, brittle hydrocelluloses, or an excessively degummed fiber.

An innovation introduced in this investigation has been the order of processing. In the old method the whole straw stalk was submitted to retting and the decortication operation followed. It was found that decortication could be accomplished on the whole stalk without previous treatment, provided the moisture content is suitable.

For the purposes of the process under discussion, it is necessary to pull the flax crop while yet green (when the seed is about one-half to three-fourths mature). This requisite derives from the fact that the quantity of lignin is much less in the immature plant, and the chemical treatment required to liberate the fiber may therefore be less drastic. That the yield of seed is materially reduced is an unfortunate fact.

The flow-sheet for the process developed at this Station is diagrammed on Plate I. The flax-straw is stapled.

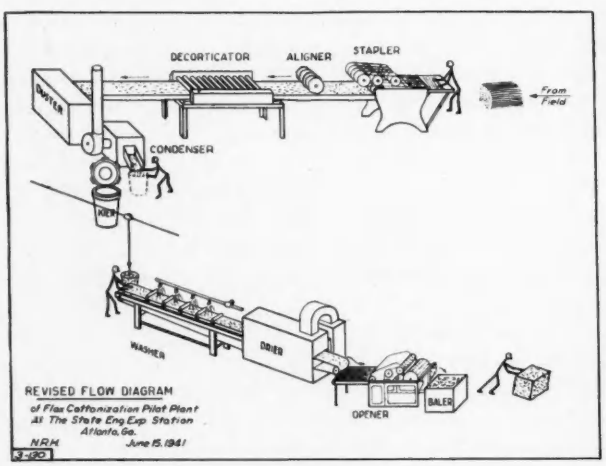
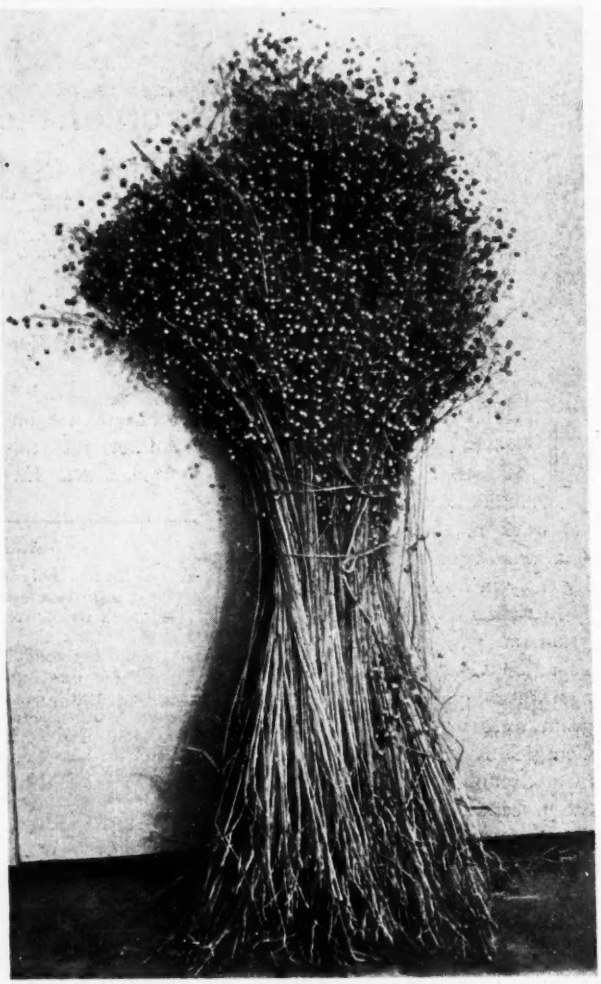
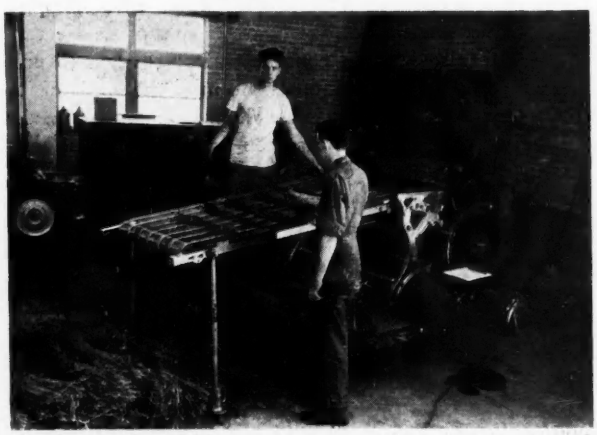


Plate I

decorticated, and cleaned in a Centrif-Air duster in a continuous process. This decorticated fiber is then transferred to a kier where it is degummed in a batch process. The degummed fiber is transferred to the washing machine where it is thoroughly washed and subsequently dried in a continuous process. From the drier it is transferred to regular cotton opening equipment and the succeeding textile operations performed.



Bundle of South Georgia Flax Straw-Triumph Variety. Straw shown with seeds.

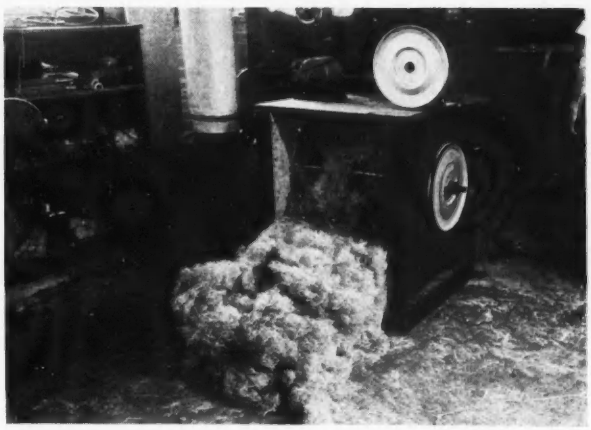


Feeding stapler which cuts straw to uniform length—approximately 1¾ inches.

(a) Stapling the flax-straw

It was found that stapling the fiber could be accomplished most conveniently by cutting the straw itself into

Decortication unit for staple straw—cut staple passes through rollers producing decorticated fiber and separating shives from usable fiber. Unit in back of operator is a dusting unit performing further separation of occluded shives.



Fiber Condenser. This unit collects usable fiber from duster unit. Fiber from duster unit passes over revolving wire drum while vacuum separation withdraws fine shive dust and air.

one and three-quarters inch lengths. For this purpose a rotary card cutter extensively used by printers was adapted by placing more knives on the shafts and adding a straw clamping device which carried the straw through the knives. The stapler is supplied by an apron that is manually fed with flax-straw placed perpendicular to the direction of movement. This whole machine is placed at such an angle that stapled straw will be delivered at least partially aligned in the direction of a conveyor belt which feeds the decorticating machine.

(b) Mechanical Extraction of Fiber: Decortication

There are three main steps required to extract clean fiber: (1) rupture of the fiber-shive bond, (2) extrication of the shive from inside the fiber layers, and (3) complete dissociation of shive from the resulting fiber. Consideration of the flax-straw structure makes it apparent that the type of stress which will most satisfactorily rupture the fiber-shive bond is shear.

Shearing stresses may be of three types:

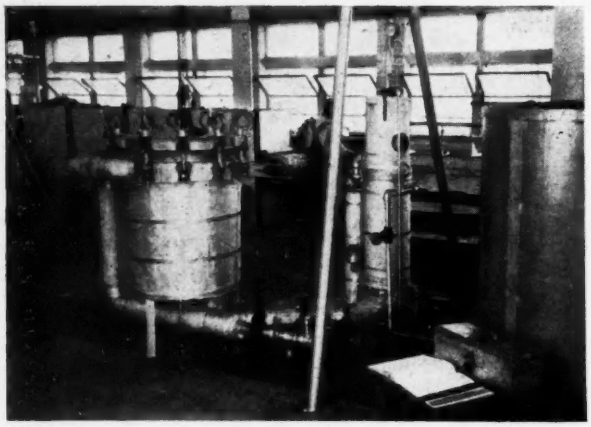
1. longitudinal—in a plane parallel to the fibers.
2. torsional—as produced by twisting the straw.
3. transverse—as caused by forces having opposite direction and acting perpendicular to the fiber length.

Many methods of decortication have been tried, though one that is completely satisfactory has not yet been found. The most successful mechanism yet tried, and the one in use at present, consists of a series of specially designed fluted rolls, the action of which gives the longitudinal shear desired. Many methods of using torsional and transverse shear have been tried with indifferent success. It is necessary to point out that the most satisfactory decortication so far performed has been on retted, stapled straw. In order to avoid its breakage, the fiber should have a moisture content of seven to nine per cent during decortication.

Tests were run using a vibrating screen next to the decorticating machine, but results did not warrant its continued use. The Centrif-Air duster, next in line of production, is a machine designed to clean cotton fibers of dirt, leaf, stem and other foreign material and is a part of the regular equipment of the cotton mill. Since its function appeared to be similar to that of eliminating suspended shive from decorticated flax fiber, this machine was tested with various kinds of decorticated flax, and because of its apparent value in removing occluded shive from fiber and certain mechanical advantages it was adopted to perform the operation of dusting the decorticated fiber. The machine will not separate shive which is bonded to fiber, but it is generally very effective in dissociating short fibers and shive from the usable fibers.

The operations just described deliver a stapled, decorticated fiber of good quality ready for the degumming process in an over-all yield of twenty to twenty-two per cent, based on the weight of straw (eight per cent moisture) used. There remains about sixty per cent of by-product shive (composed mainly of cellulose and hemicellulose and lignin), and about three per cent of by-product short fiber. This leaves from seven to nine per cent of the original weight for rejections and handling losses in the process up through the decorticating-dusting stage.

Since shive constitutes such a large part of the material handled it is well to observe that it is composed of approximately 50 per cent alpha cellulose, 17.5 per cent pentosans, 6.5 per cent pectic acid, 8.5 per cent moisture, 5.55 per cent ash, 4.55 per cent alcohol extract (fats) and the remainder is composed of various extraneous materials found in woody tissues of plants. It was found that approximately nine per cent of furfural could be obtained from shive, using Tollen's procedure[8]. Although this is a good yield of furfural, there are numerous cheap sources of this product and it is questionable whether processing shive in this manner would be profitable. P. Eckert and K. Plaeschke[9] have investigated the utilization of shive in the paper and rayon industries, and have found that the sulfate process gives the better product, but still the



Kier Unit. The chemical degumming of the decorticated fiber is carried out in this unit. Pressure is 80 lb. per sq. inch, temperature 165 deg. C., kier charge 60-70 lbs.

quality of the pulp is not comparable with that from coniferous woods. Its use in these industries is therefore definitely limited. It appears also that shive is slightly inferior to ground wood flour as a filler for plastics; power consumed in grinding the shive and proximity to the plastics manufacturer would be of critical importance in this use of the by-product. The material may also have possibilities for use in brick manufacture, but its most important present use is as a fuel since it affords approximately 9,400 B.T.U. per pound.

(c) Degumming

The condition of fibers before textile processing is directly determined by the degumming and subsequent washing, drying, and opening processes. The textile quality of fiber is judged on four main points:

Length—should be uniform.

Diameter—should be small and uniform.

Strength—should be great.

Softness—should approach that of cotton.

In the ideal case the fiber should be received for degumming absolutely free of shive, and it should be uniformly degummed under optimum conditions of liquor concentration, temperature, pressure, and time. The degummed fiber should be evenly and completely washed, and dried in such a manner that fiber bundles do not cohere. This dried fiber should then be opened into a fluffy mass with no fibers being broken. These considerations have guided our investigations to this point.

It has been observed that the best textile qualities yet obtained have been produced by degumming fiber from water-retted straw. The bacterial action of retting appears to remove just the right amount of gums, leaving enough for the final fiber to be superior for textile purposes. For this reason retting and other processes to effect the same result have been investigated.

The retting process probably occurs in four steps:

1. the solution of water-soluble constituents of the plant.
2. beginning of bacterial action accompanied by a rise in acidity.
3. loosening of the fiber bundles.
4. attack on the fiber bundles.

For best results the retting should be stopped upon completion of the third stage. Our investigation has shown that the best retting occurs in water free of salts, the optimum temperature for the retting bath is about 33° C., and that water retting can be satisfactorily performed on stapled straw.

Although it has been found that bacteria-retted straw affords superior fibers, the retting process requires a comparatively long time for completion and hence extensive tank space. It was deemed desirable, therefore, to investigate faster methods. In the present process the unretted, decorticated, dusted fiber is degummed directly, this being particularly advantageous since it is also necessary to degum the retted fiber.

Among the other straw-treating processes investigated were steaming, cooking in water at high temperature, and cooking in solutions of 1 per cent and 0.5 per cent sodium sulfide, sodium carbonate, sodium hydroxide, acetic acid, mixtures of sodium hydroxide and sodium sulfide, and of sodium carbonate with sodium sulfide. The time employed in these trials was varied, but all took place at a high temperature (about 165° C.). None of these treatments proved very satisfactory because the wood was rendered too flexible for effective decortication and fibers were too "ribbony." It was subsequently shown that a pre-treatment of the decorticated fiber with hot dilute acetic acid is advantageous, but not equal or superior to results obtained from processing retted straw.

In the early experiments the possibility of extracting the gums and pectins from the fiber by means of organic solvents was considered and tried. Ether, various alcohols, chloroform, and acetone were tried without success.

The possibility of imparting a curl (for ease in handling in cotton machinery) to the fiber before degumming was investigated. It was demonstrated that a curl could be given by treatment with cold, strong caustic, but that the curl was not permanent and the method of treating the fibers was expensive.

The degumming process developed employs a treatment of decorticated fiber (retted or unretted) with a mixture of one to two per cent water solution of sodium carbonate along with two to six per cent of sodium sulfide for one-half to two hours in the kier at 160-165° C. This method requires no preliminary treatment or washing of the fiber and since its development no other method has been found which equals or surpasses it.

There are no marketable by-products from the degumming step. It is possible, and indeed important for more economical processing, to recover the chemicals used for degumming.

WASHING AND DRYING THE DEGUMMED FIBER

In the first experiments in washing and drying the

[6]Tollens, *Paper Trade Journal 87*, 59 (1928).
[7]Eckert and Plaeschke, *Papierfabrikant 36*, T113 *et seq.* (1938).

Feeding partially washed kier stock to final washer.

Washed stock being fed to conveyor dryer.

degummed fiber it was sought to employ the centrifugal method. Extensive tests, however, demonstrated that the washing in this method was uneven and inefficient and that the fiber matted so seriously that it was hardly adapted for use in cotton breaking equipment. The centrifugal method is also a batch process and undesirable for this reason.

A washing and drying assembly was therefore designed that is continuous and efficient, and produces a fiber that is relatively unmatted and ready for the breaker. It consists principally of a screen conveyer belt (constructed in the laboratory from narrow width screening wire) which is fed with the degummed fiber so that it lies in a thin layer on the belt. It passes through a series of rubber rollers which express the water from the fibrous material. Placed alternately to the rollers is a series of jets which spray water from above and below. The alternate spraying and expression of solution follows the laws of extraction and affords very efficient washing. Although fresh water is used in each spray in the present equipment, it is thought that by installing a series of pumps one may take advantage of the counter-current principle and effect an appreciable economy of water. The clean, degummed fibrous material is conveyed directly and continuously into a tunnel dryer which dries the material and delivers it in a condition suitable for the cotton openers.

The pilot plant now in use is capable of producing ten to fifteen pounds per hour of stapled degummed fiber.

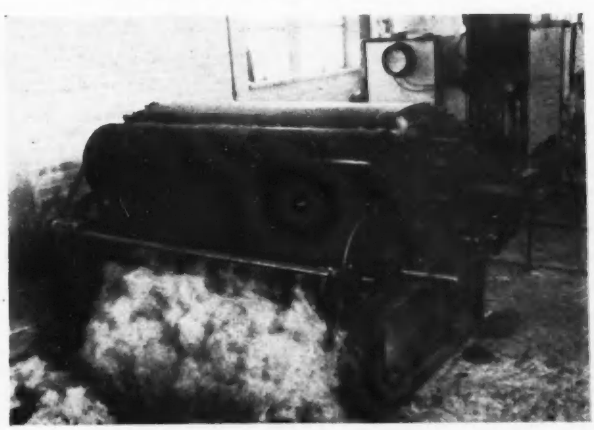
COTTON-MILL PROCESSING AND SPINNING

Considerations of space forbid a detailed account of the numerous tests on processing and spinning of the linen fiber. The success of processing and spinning of all-flax yarn entirely on cotton-textile machinery is dependent upon the quality of the fiber supplied. There have now been developed methods which make it possible to spin low-count (coarse) all-flax yarn from water-retted, scrutched, hackled, degummed, stapled fibers, and from stapled, decorticated, chemically degummed fibers. In the latter case, however, considerable further improvements and investigations are necessary in order to improve length uniformity, fiber diameter, and to make it economical for cotton machinery processing.

The dried fiber was run consecutively through a waste opener, a single process picker (two sections with carding beaters), drawing frames, long draft slubber roving frames, intermediate roving frame, and a long draft spinning frame. It was observed that before flax fiber can be

Dryed stock coming from dryer and going to opener feed belt.

Opened stock discharging from opener unit.



successfully processed on cotton machinery, it must be uniformly degummed and properly washed and dried. This is true for both retted and unretted material, since the retting process leaves the fibers too coarse and stiff to be worked by the cotton equipment. The superior strength and more favorable opening characteristics of the water-retted fibers after degumming enabled them to come through processing with less breakage than was suffered by the unretted, decorticated fibers. As a result a more uniform, and consequently stronger yarn was spun from the retted fibers.

The short by-product fiber from the cotton opening equipment can be used in a variety of ways, one of which is in yarn strengthened with resin and another as the raw material for fine cigarette paper. Much of the success of the proposed process depends upon the credits obtained from these by-products.

One of the stated objects of this investigation has been to produce short-stapled flax fiber that may be blended with cotton and the blend worked on cotton machinery. The number of combinations possible assume large proportions when it is considered that varying proportions of flax, cotton, rayon, and other fibers may be blended. No difficulty was experienced with several blends prepared in our laboratory. It therefore seems safe to assert that any of the pilot plant fiber, whether processed from unretted or retted straw, can be successfully used in yarns in this manner.

Because of the relative coarseness of some degummed flax fibers, it has been suggested that they could be more satisfactorily processed and spun into yarn on the woolen system than on the cotton system. The yarn spun on the waste woolen systems was limited to low-count and low-twist because of the nature of the machinery. After a twist corresponding to that induced by the cotton system had been added to it, the yarn prepared on the woolen system was more uniform and stronger than that prepared on the cotton system.

It was conceived that, although chemically degummed yarns would undoubtedly have lower tensile strength than those from stapled, water-retted flax, the fabric which has been taken through the various finishing processes would perhaps be just as strong. Though results are too few for definite statement, it appears that finished fabric from linen made by the cotton system compares favorably with fabric made from water-retted linen yarn.

WEAVING AND FINISHING

Work in sizing, weaving, and bleaching was undertaken to obtain data, to develop processing methods, and to produce fabrics for purposes of comparison. Selected for comparison were fabrics from the following:

1. line flax yarn (linen system)
2. retted, stapled, degummed line flax (cotton system)
3. retted, stapled, decorticated, degummed flax (cotton system)

The warp breaking strength of one-inch strips (thirty ends per inch, yarn counts 6's) was respectively: (1) 87.0 lbs., (2) 69.0 lbs., (3) 54.0 lbs. It was necessary to bleach the No. 3 fabric strongly because of residual shive.

Work is being continued for the purpose of improving the method and the product. At present a systematic study, including microscopic examination, is being conducted in order to locate points in the process causing damage to the fiber, and to determine the effect of soil, climate, time of planting, time of harvesting, etc., on the properties of the fiber. Methods of growing flax are being considered systematically, and methods of speeding and improving the processing are constantly being checked.

It has not been considered relevant to the discussion to treat the economics of the process. Markets are too unsettled and processing is on too small a scale to allow fair estimates of costs. Although some data are at hand, they will become increasingly comprehensive and accurate as experience is gained.

CONCLUSIONS

1. A pilot plant has been constructed capable of producing ten to fifteen pounds of stapled, degummed fiber per hour.

2. The results of processing degummed, stapled line-flax fiber have shown that all flax yarns can be spun practically on the cotton system and that the resulting yarns can be woven into a fabric, provided the quality of the fibers is sufficient for cotton mill processing.

3. The quality of the fiber now being produced in the pilot plant from retted or unretted flax straw is as yet insufficient for practical spinning of one hundred per cent flax yarn on the cotton system.

4. The stapled flax fiber may be blended with cotton and other stapled fibers quite satisfactorily.

ACKNOWLEDGMENT

We wish to acknowledge with sincere gratitude the assistance of Mr. S. Jack Davis, Research Department, Callaway Mills, LaGrange, Georgia, in the preparation of this paper, and the valuable criticisms and loyal efforts of the project staff throughout this investigation: Messrs. O. C. Falkovich and D. W. Smith, of the Tennessee Valley Authority, and Messrs. Irving Barnett, C. P. Goodyear, W. V. Hassett, N. R. Henry, R. L. Hill, and G. A. Rosselot, of the State Engineering Experiment Station.

CALENDAR of Coming Events

Meeting, Northern New England Section, December 12, 1941.

Meeting, New York Section, January 23, 1942, Chemists' Club, New York, N. Y.

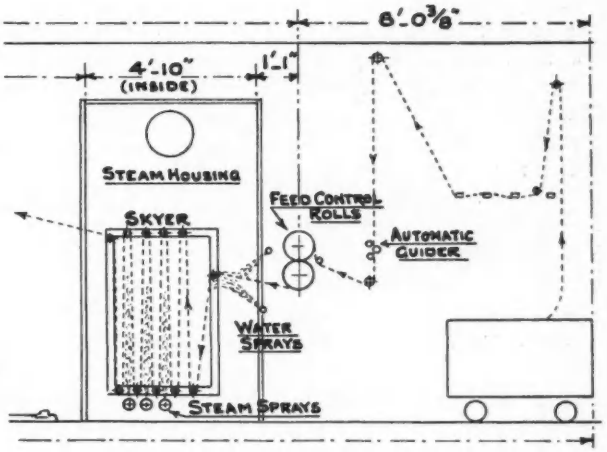
Intersectional Contest—

The Evaluation of FINISHING AGENTS for Sanforizing

Presented by Andrew J. Kelly for the South Central Section

IT is assumed that those interested are familiar with the method of controlled preshrinking of textile fabrics known as "Sanforizing." In December, 1931, at the 50th anniversary meeting of the A.S.M.E., Mr. Sanford L. Cluett described it thus: "The sanforizing process is, broadly stated, one for predetermining the superficial dimensions of a fabric and at the same time conserving and usually improving its finish. The process has been built on the principle that inasmuch as the causes of the shrinking of fabrics when they are subjected to a full laundry treatment are mostly mechanical, the most effective treatment to prevent shrinking may be found in some process of mechanically rearranging the fibers of the fabric (including changing the count of warp and filling) to the same extent that the fibers would arrange themselves if subjected to a full washing in a laundry."

The finishing of textile fabrics scheduled for sanforizing usually predicates a type of wetting peculiar to the shrink-proofing operation. Ordinarily, surface-active agents are dissolved in water to form a solution which must provide adequate wetting to textiles entered therein. In the finishing of cloth to be sanforized, one of the prime wetting requirements is a subsequent, or secondary, effect. The cloth so finished should acquire the property of rapidly and uniformly absorbing moisture when the *dry* fabric is exposed to a plain aqueous spray. Following the finish bath the dried fabric may be entered immediately into the sanforizing range or it may be held for an indefinite period. It is therefore desirable that the absorbency be not quickly lost. Upon entering the range the cloth is sprayed and it is at this point that the moisture absorption is necessary. This is an important part of the process and uniform take-up here has a considerable influence upon final results. If the fabric wets rapidly and well little surplus moisture is carried, drying is faster, and the productive capacity of a unit increased. This particular phase of the sanforizing operation is known variously as re-wetting, wetting-back, or secondary wetting. Many auxiliary products have been offered and applied for the purpose of conferring good wetting-back properties to the cloth or of enhancing its inherent absorbency. The term "finishing agent" for the purpose of this paper is confined solely to these auxiliaries. In spite of the immense yardage of goods sanforized (over a million miles in the first 10 years of the process) there is no accepted standard method for the evaluation of such products. We hope to offer at least the basis for such a method.



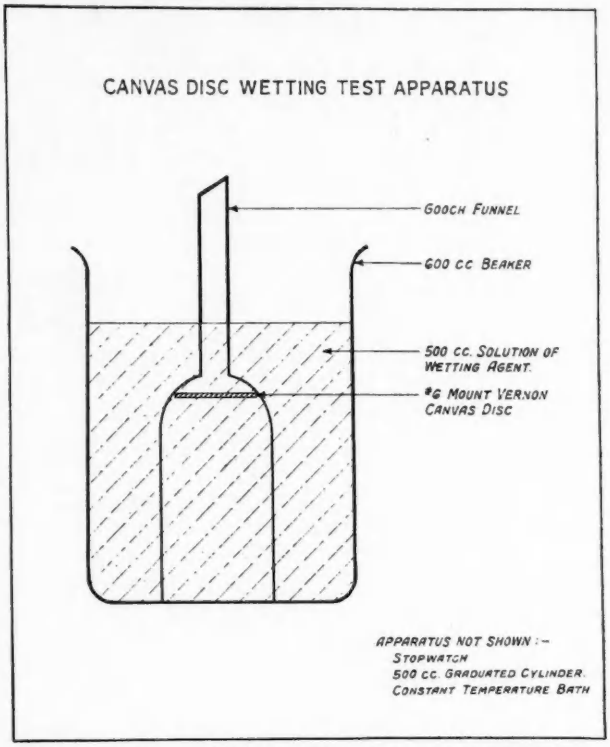
Early Stages of Sanforizing Process.
Courtesy, Cluett Peabody & Co.

Quite naturally, individual mill chemists have evolved for themselves test methods to provide comparison between competitive items and in particular to check new samples as submitted. Usually they closely parallel actual mill practice inasmuch as the proposed product is applied to a test fabric which is then dried and checked for absorbency. This simple, rational procedure was accepted without question as the outline for any method of evaluation which might be adopted. Simple and rational though it is, however, the possible variations are many. There may be differences in the concentration and temperature of the solution of rewetting agent, manner of application to the test fabric, type of fabric selected, and procedure for determining absorbency. Most of these variations do occur in practical mill tests. Concentration of auxiliary may run from 0.1 per cent to 5.0 per cent; temperature from atmosphere (with attendant fluctuations) on up; and a similar diversity in the manner of wetting-back. For this last, a common procedure is the "wick-up." The finished test fabric is cut into strips or "wicks" and partially immersed in water—the height of the capillary rise in a measured time is then determined. Some who

practice this, report difficulty in exactly measuring the rise, the difficulty varying with the color and physical character of the fabric. Others cut the cloth into squares and clock the time required for the swatches to sink in tap water. Curling of the corners, particularly in light constructions, is a deterrent to uniform results. It was found that cutting the cloth into discs instead of squares largely obviated this nuisance. Variations in the temperature of the tap water caused great differences in sink times.

These and such other mill practices as came to light were carefully considered, as were suggestions offered in answer to queries. Ignoring for the moment the method of applying the secondary wetting agent to the test fabric, the effect to be determined is the same as in the tests for the evaluation of primary wetting agents; with the essential difference, already mentioned, that water alone is the wetting medium. Hence the standard mill methods for the evaluation of such wetting agents could be expected to provide a ready-made procedure. These are, of course, the official A.A.T.C.C. method (commonly known as the Draves' test) and the Canvas Disc Wetting Test. The official method evalues wetting on cotton test skeins, and was abandoned in favor of the latter which employs a woven fabric. The same material used, Mount Vernon No. 6 Canvas, was selected as test fabric for the same reasons which gained it original acceptance — a good average fabric well suited for such work, and nationally available. Since it had already been found that discs were preferable to swatches of other shapes, this choice was inevitable. Lastly, the one inch size was adopted because it was standard for the method and was convenient for use. Great numbers of these canvas discs can be punched out in short order using a one inch steel die as suggested by the inventors of the test method. Thus the selfsame discs could be used for determining both primary and secondary wetting. The sketch, taken from the original publication of the method in "Dyestuffs," shows the simple apparatus but it is no doubt familiar to all. The canvas disc is placed in the Gooch funnel which is then rapidly inverted into the solution of wetting agent. The disc is held beneath the surface of the liquid—and the time required for it to sink is measured. The test is quick, simple, and quite reliable—the apparatus is found in most laboratories or is easily obtained.

It is in the actual application of the auxiliary being tested that departure is made from standard evaluation methods. The wetting effect of the solution, while important, is not the prime consideration. In determining the concentration for test of any wet-processing agent, even after consideration of the factors involved, the figure chosen is necessarily an arbitrary one. For impregnation of the canvas discs, a 1 per cent solution was taken as average. With this as a basis, equal money value solutions of any product may be made, or comparisons may be all made at the same strength. Higher concentrations of effective auxiliaries were found to show little improvement in wetting-back, while lower concentrations of some products increased the re-wetting time to an unreasonable degree. Another arbitrary figure, that of 120° F., was selected for the impregnating bath—it represents a fair compromise between a cold bath and a moderately hot one. Some of the surface-active agents recommended for sanforizing finishing are slowly or difficultly soluble at this temperature—there is no objection to making such dispersions in hot or boiling water and then cooling to 120°. The discs are entered into the solution and mildly agitated until saturated (five minutes was found to be adequate if a padding effect is maintained). The bath is then poured off and the discs laid between paper towels—six thicknesses below and six above—and pressed by rolling 12 times with a rubber roller weighing two pounds. They are then dried between fresh paper towels with a moderately hot iron. A total of 16 discs was used for each test, padded in 100 ml. of solution contained in a 250 ml. beaker. This number is about right to give the desired series of sinks, though it is not fixed.



Taken from "Dyestuffs," September, 1938. (Vol. XXXV, No. 7). Published by National Aniline & Chemical Co.

Possible variables are easily noted in the foregoing. It must be stressed that this procedure is principally intended to yield comparative results. As in all tests by comparison every effort must be made by the individual to maintain uniformity and to give each group of discs the exact same handling.

One hour after drying the initial test for secondary wetting is made. Each disc is placed in the Gooch funnel

and the wetting-back time measured in exactly the same manner employed in making tests by the Canvas Disc method, except that 500 ml. of plain water comprises the wetting bath. Thereafter further sink times were determined at the end of 24 hours, 72 hours, one week, and one month. Three discs were sunk at each interval and the average was listed as the wetting-back time of the fabric or the secondary wetting time of the auxiliary. Distilled water was used but tap water gave results showing no appreciable difference. It may be safely stated that distilled water is not essential, and tests should be run in the regular mill supply.

The temperature of the re-wetting bath markedly influences the absorbency of the canvas—high temperatures in many cases give immoderately short sinking times. It is most important that the temperature for this operation be kept constant, and all of the discs were tested for wetting-back in water at 77° F. This was accepted as standard although it too may be varied where conditions warrant a change.

Table 1 shows actual results obtained using the described method of evaluation on eight commercial auxiliaries commonly applied as sanforizing finishes. The chemical nature of the agents is believed to be correct as given but this information, reasonably enough, is not always exactly available.

Examination of these findings showed the existence of some discrepancies between test results and actual mill runs. Item No. 1 for instance had been rejected in one plant on the basis of superior performance by item No. 8, though the rewetting test showed up No. 8 as being quite inferior. On the other hand item No. 6 was known to have gained mill acceptance through practical mill runs, yet its showing is very poor. A possible cause of such variance was quickly brought to light. In the finishing operation starch, gum, dextrine, fillers and other sizing materials are frequently applied in addition to the secondary wetting agent. It seemed desirable to experiment further incorporating one or more of these ingredients in the padding bath. A full discussion of the various combinations tried is not necessary here. Starch and gum mixtures were generally too viscous and were difficult to keep uniform. Introduction of other sizing and finishing materials made the bath too complex and presented too many additional variables. An alternate procedure was finally evolved retaining all features as already given but using a 5 per cent pre-boiled solution of white corn dextrine as the basis of the padding bath. Into this dextrine solution the same quantity of each of the 8 auxiliary products was incorporated and the tests repeated as outlined. Table 2 shows the results. Mill findings are quite closely checked and the discrepancies mentioned have largely disappeared. Many textile chemists may, no doubt, consider this alternate procedure unnecessary and accept good showing in the original method as sufficiently promising to justify a mill run.

EVALUATION OF SECONDARY WETTING PROPERTIES, USING MODIFIED CANVAS DISC METHOD

Approximately Equal Money Value Solutions, Based on 1% as Standard

TABLE 1. Applied in Water
TABLE 2. Applied in 5% Dextrine Solution

Type of Auxiliary Product	*Wetting-Back Time in Seconds*				
TABLE 1	*After 1 hr.*	*After 24 hrs.*	*After 72 hrs.*	*After 1 wk.*	*After 1 mo.*
1. Nitrogen condensation product	5.0	7.2	7.0	8.4	11.2
2. Na salt of sulfo-dicarboxylic acid	21.8	27.6	40.0	47.2	48.8
3. Solubilized mineral oil	31.0	29.2	35.2	30.0	32.4
4. Alkyl aryl sulfonate — solvent compound	7.0	5.2	6.8	9.8	12.0
5. Protein-fatty acid condensate	2.2	3.0	4.4	5.0	7.2
6. Cation-active anion-active compound	147.0	130.0	180.0	220.0	184.0
7. Na salt of alkyl aryl sulfonate	5.6	10.2	12.4	10.0	18.2
8. Sulfonated mineral oil	20.2	17.4	20.8	18.2	18.2
TABLE 2	*After 1 hr.*	*After 24 hrs.*	*After 72 hrs.*	*After 1 wk.*	*After 1 mo.*
1. Nitrogen condensation product	37.0	54.2	54.0	51.4	62.8
2. Na salt of sulfo-dicarboxylic acid	14.4	17.8	22.2	27.8	28.4
3. Solubilized mineral oil	6.6	6.4	6.4	7.8	12.0
4. Alkyl aryl sulfonate-solvent compound	4.8	5.2	5.6	5.8	11.2
5. Protein-fatty acid condensate	8.0	14.2	10.6	14.2	27.0
6. Cation-active anion-active compound	3.2	3.2	3.8	3.6	4.8
7. Na salt of alkyl aryl sulfonate	13.6	19.2	18.4	23.6	64.0
8. Sulfonated mineral oil	10.2	16.2	14.6	15.2	14.0

Briefly, the procedure consists of three simple operations:

1. Impregnation of canvas discs in aqueous solution (or, alternately, in dextrine solution) of auxiliary being evalued.
2. Drying of discs under uniform conditions.
3. Wetting-back at regular intervals using modified Canvas Discs method with plain tap water.

We believe this offers a simple but quite effective means for the evaluation of the secondary wetting properties of sanforizing finishing agents. Comparison of results with actual mill findings tends to confirm this belief.

MEMBERSHIP CARDS

Membership cards have been mailed by the Secretary in acknowledgment of renewal dues received in October and November.

Intersectional Contest—

☆ *Winner of Second Prize*

Testing Vat Dyed Cotton for Fastness to HYPOCHLORITE BLEACHING

Presented by Charles A. Seibert for the Philadelphia Section

THIS subject is of present interest principally because the Federal Specifications for color fastness of cotton fabrics for military use includes the provision that they withstand an immersion for one hour at room temperature in a sodium hypochlorite solution containing 0.7 per cent available chlorine. This is not a recently introduced provision. It was made effective prior to May, 1933. In the interval between its adoption and about a year ago, the test procedure as described in the specifications appears to have served its purpose satisfactorily. However, soon after the preparedness program got under way, differences of opinion arose between the United States Army Quartermasters Depot and contractors in respect to the satisfactory performance of contract deliveries when subjected to the test. The laboratories of the dye manufacturers and of the dyers and finishers were quickly involved and busy making an endless array of tests. This condition naturally led to an examination of test procedures in general use.

In addition to the one described, two others were found and considered acceptable because they had the approval of some recognized group in the textile industry. The portions of these test procedures that are pertinent to this discussion are: Federal Catalog CCC-T-191a, subdivision 10—Fastness to Laundering Agents Containing Active Chlorine; "The specimen is immersed for one hour at room temperature in a sodium hypochlorite solution containing 0.7 per cent available chlorine and thoroughly washed and dried." American Association of Textile Chemists and Colorists—1940 Year Book—page 174—"The dyed or printed cloth is saturated with bleaching powder solution or sodium hypochlorite solution containing the required amount of available chlorine, squeezed immediately to remove the surplus solution and allowed to lie for one hour at room temperature (70-75° F.-21-24° C.) wrapped in cloth or placed in a closed vessel."

Commercial Standard CS59-41—Sub-division V—Paragraph 14a—"The sample to be tested is saturated with a sodium hypochlorite solution containing 0.1 or 0.01 per cent available chlorine, squeezed immediately to remove the surplus solution and allowed to lie for one hour at a temperature of 70-75° F. (21.1 to 23.9° C.,) wrapped in a cloth or placed in a closed vessel. The specimen is then washed with water and treated with a 1 per cent solution of sodium hyposulfite at 120° F. (48.1° C.) to remove the chlorine. The specimen is washed again with water between 70-75° F. (21.1-23.9° C.) for five minutes and then dried."

It will be observed that the Commercial Standard procedure contains more detail than the others. This is natural because it was approved in 1938, whereas the A.A.T.C.C. procedure was formulated as early as 1925 and the Federal Catalog procedure earlier than 1933. The lack of now recognized necessary detail in the A.A.T.C.C. test procedure may be explained by the fact that when it was formulated it was customary to bleach fabrics containing colored threads with hypochlorite, whereas in the interval the peroxides have gradually replaced the hypochlorite for this purpose. The reason in respect to the Federal Catalog procedure is probably because relatively small quantities of dyed cotton cloth for military use had been purchased between 1933 and a year ago and there are vat dyes that will satisfactorily withstand the test even when it is applied under conditions that are most severely color destructive; low pH. However, the quantities of cloth required for military purposes have increased within the past year beyond the combined capacity of the dye manufacturers to produce what is required to color it with the dyes of known best fastness exclusively, and some substitutes must be used, principally in combination with the better dyes. Their use does not lower the high standard of serviceability prescribed for these fabrics and we would probably be unaware of the substitutes were it not for the fact that they exhibit sensitivity in this specific test, which is only one of a number prescribed for color fastness properties. It should also be remembered that this test is not directly comparable with any condition to which the fabric will be subjected during its use. The test is much more severe and purposely designed to detect possible weakness or sensitivity under abnormal and unusual conditions during use. The chemist and those who use sodium hypochlorite for bleaching cotton under practical conditions know that it is more active at 100° F. than at 80° F. and that increasing its pH increases its stability. It was, therefore, natural to suspect the necessity for a careful control of these two conditions to secure consistent reproducibility. Sodium hypochlorite is manufactured in large volumes for home laundry use and is available in chain grocery stores under a variety of trade names. These are useful for test purposes under the controlled conditions later described, whereas some of the trade named products

available in drug shops, principally prepared for antiseptic use, are not.

Federal Catalog O-B-441a contains specifications for five types of chlorinating agents. Only one of these is for sodium hypochlorite in solution and it states that the solution must be free of sediment, shall contain not less than 10 per cent by weight of available chlorine and not more than 1.5 per cent of free alkali in terms of NaOH.

This pamphlet describes in detail procedure for determining the available chlorine and the free alkali in both dry and liquid hypochlorite, as does the A.A.T.C.C. Year Book. While these two procedures are not identical in detail, both appear satisfactorily useful. They differ principally in respect to detail for determining the free alkali. This is not particularly important because resort to titration for the control of free alkali is not required for testing purposes. In all of the trade named products examined for the present experiments, the free alkali was found to be principally in the form of the hydroxide (caustic soda) with lesser quantities in the form of carbonate. Measurements of pH values with a selected pH meter or potentiometer permitted consistent arrangement in the proper order of both sodium hydroxide and carbonate solutions in respect to their known content and, therefore, measurements with this pH meter were accepted as adequate for test control purposes. There are several pH meters available but only one to our knowledge with an electrode that permits of direct readings of the higher pH values required for the present tests purposes.

Naturally, the first experiments were to determine the available chlorine content and pH values of the trade named products for home laundering use. Twelve products were examined. Their pH values varied between 9.2 and 12.6 and their available chlorine content between 4.1 and 5.4 per cent. Later, samples from sources that supply commercial laundries were secured. These, while of higher chlorine content, were within the pH values described. Table 1 describes the pH and chlorine content of seven of the samples. These were selected because we were informed by the stores from which they were purchased that they were sold in the largest volume.

TABLE 1

	pH	*Available Chlorine Content*
Clorox	9.2 - 10.5	4.5 - 5.41%
Dazzle	11.4 - 12.4	4.1 - 4.5
Emerald	12.2 - 12.5	4.4 - 4.59
Javex	12.2 - 12.5	4.9 - 5.09
Oxol	12.2 - 12.6	4.6 - 4.7
Rainbow	11.2 - 12.4	4.7 - 4.9
Whitesail	11.2 - 11.8	4.4 - 4.7

The differences between the lower and higher figures are explained by the fact that at least three different samples of each product was purchased at different times and as required for the many tests made. Also because various quantities were taken from each sample as required, the stopper replaced and the sample preserved until again required. Some samples were in use for periods as long as three weeks. A quantity removed is naturally replaced by air which has a greater influence to reduce the chlorine content than it has to disturb the pH. Tests were made to determine how much the original available chlorine content could be lowered by natural causes before the hypochlorite became useless for testing. Some samples were allowed to stand until their available chlorine content was reduced to one-half the original, principally as a result of the action of the air that replaced quantities removed from the bottles. This required as long as eight weeks in some instances and at the end of that time, the samples were still found satisfactorily useful. The continued use of hypochlorite solutions after the chlorine content has reduced materially is not recommended. The solutions should be kept in colored bottles, well stoppered, protected from strong light and at low temperatures, preferably in a refrigerator at about 60° F. if one is available.

We were very much surprised to discover that the pH values of distilled water were in some instances as low as 5.5 and that that condition was not due entirely to absorption of carbon dioxide from the air. Consideration of causes is not pertinent for the present and the fact is mentioned only because the pH of the water used for dilution will naturally influence the pH values of the diluted solutions. Table 2 describes the pH of the hypochlorite solutions before and after dilution to 0.7 per cent with distilled water of 6.2 to 6.4 pH.

TABLE 2

	Initial		*After Dilution*	
	pH	*Chlorine*	*pH*	*Chlorine*
Clorox—Sample 1	10.39	4.51%	9.96	0.7%
Clorox—Sample 2	10.51	4.60	9.98	0.7
Dazzle	12.41	4.12	11.92	0.7
Emerald	12.20	4.60	11.64	0.7
Javex	12.31	5.10	11.81	0.7
Oxol	12.50	4.80	12.11	0.7
Rainbow	12.25	4.92	11.74	0.7

The relatively large differences in the degrees of color change between identical samples of dyed or printed fabrics tested in the lowest and highest pH values cannot, unfortunately, be clearly illustrated with photographs. They are, however, readily or understandingly described as the difference between being acceptable at the higher and unacceptable at the lower in respect to the color change effected in testing. While it is recognized that materials colored with dyes of the best fastness show relatively small differences when tested under these extremes of pH variations, it must also be emphasized that every shade or color required or desired cannot be produced with the dyes of established best fastness. Incidentally, it is well known that the dyes of best fastness may show some color change when used in small quantity for shading and absolutely no color change when dyed in a deeper shade. 0.7 per cent chlorine is considerably more concentrated

TABLE 3

Beckman pH Meter—Model G
Electrode—Type E, Glass High pH
Adjustment Control—Eimer & Amend Buffer pH 10 ± .01

Experiments Made 6/4/41	*Initial pH*	*Diluted to 0.7% with Water of pH 7.6*	Reduced to 0.7% Available Chlorine with a Buffer consisting of the relative proportions indicated—						
$NaHCO_3$ (2% sol.)	8.11		30	30	30	30	30	30	30
Na_2CO_3 (2% sol.)	11.22		70	70	70	70	70	70	70
		pH							
Clorox—Sample 1	10.39	9.96	X	..	..	..	..	..	..
Clorox—Sample 2	10.51	9.98	..	X	..	..	..	..	..
Dazzle	12.41	11.92	..	..	X	..	..	..	..
Emerald	12.20	11.64	..	..	..	X	..	..	..
Javex	12.31	11.81	..	..	..	..	X	..	..
Oxol	12.50	12.11	..	..	..	..	..	X	..
Rainbow	12.25	11.74	..	..	..	..	..	..	X
pH at °C.	27-28	37-39							
pH at °C. 27-28			9.95	9.95	10.2	10.06	10.15	10.5	10.1
pH at °C. 37-39			9.68	9.78	10.3	9.9	10.0	10.34	9.98
After standing 1 hour at 39-37° C.			9.70	9.70	9.99	9.83	9.91	10.25	9.91

Experiments Made 6/4/41	*Initial pH*	*pH*	Diluted to 0.7% Available Chlorine with a Buffer composed of the proportions indicated—							
$NaHCO_3$ (5% sol.)	7.98	30	20	20	20	20	20	20	20	20
Na_2CO_3 (5% sol.)	11.3	70	80	80	80	80	80	80	80	80
Clorox—Sample 1	10.39	..	..	X	..	..	..	..	..	..
Clorox—Sample 2	10.51	..	..	..	X	..	..	..	..	..
Dazzle	12.41	..	..	..	..	X	..	..	..	..
Emerald	12.20	..	..	..	..	..	X	..	..	..
Javex	12.31	..	..	..	..	..	..	X	..	..
Oxol	12.50	..	..	..	..	..	..	..	X	..
Rainbow	12.25	..	..	..	..	..	..	..	..	X
pH at ° C.	27-28									
pH at °C.	27-28	9.8	10.0	10.0	9.98	10.1	10.04	10.08	10.23	10.06
pH at 39-37° C.		9.95	9.78	9.8	9.80	9.95	9.9	9.92	10.06	9.9
After standing 1 hour at 39-37° C.		9.68	9.95	9.82	9.75	9.85	9.8	9.85	10.00	9.83

than is generally required for testing, however, pH variations in 0.01 per cent solutions will cause differences on fabrics produced to withstand treatment in that strength of solution: a color fastness requirement described in Commercial Standard CS59-41. Incidentally, a satisfactorily useful test procedure should include provisions that ensure reasonably consistent reproducibility.

This brings us to a consideration of what pH values should be established for testing. A questionnaire to about twenty dyers and a similar number of printers of cotton and rayon fabrics, disclosed a preference for a compromise between the higher and lower, or between 10.0 and 10.4. The next step was consideration of a buffer system to produce and control pH within these limits. Two systems were recognized as available: the phosfate and the carbonate. The latter was chosen because much larger variations in the relative proportions of the components are required to alter the pH. This was considered an advantage because less accuracy in measurements of quantities is required.

The second and third column figures in the lower half of Table 3 illustrate that a 30-70 part mix of 5 per cent solutions has a pH of 9.8 and a 20-80 part mix, a pH of 10, a difference of only 2/10 of a unit with a 10 part change in the buffer components, yet a 20-80 part mix will buffer to within 4/10 of a unit hypochlorite solutions varying in initial pH between 10.4 and 12.5. Table 3 also illustrates the differences between the effectiveness of 2 and 5 per cent solutions. Obviously, the 5 per cent solutions are most useful for the present purpose.

The tendency of temperature variation to influence the pH values as measured by the instrument is also illustrated. The last or lowest line of figures in each of the two tables are the pH values of the solutions after they had been used for testing. They were taken more than one hour after preparation of the solutions and they illustrate convincingly the stability of the solutions when properly buffered.

Some further information in respect to the effectiveness of the buffer recommended in the detailed test procedure that concludes this report, is provided in Table 4. It requires no explanation except to state that the one product (OXOL) which was not buffered to within the values desired: 10—10.4 is no longer available. It was replaced at least three years ago by the product named (DAZZLE). When its peculiarity was brought to the attention of the manufacturer, no information of value to explain its behavior could be obtained. The manufacturer appeared rather startled by the fact that a sample was still available in the domestic trade.

TABLE 4

Tests to Determine the Usefulness of a Sodium Bicarbonate-Sodium Carbonate Buffer System to Control the pH of Sodium Hypochlorite Test Solutions

	Trade Names of the Sodium Hypochlorite Solutions Used for These Tests					
	Clorox	*Dazzle*	*Emerald*	*Javex*	*Oxol*	*Rainbow*
Initial Chlorine	5.41%	4.51%	4.59%	5.09%	4.70%	4.70%
pH	10.14	12.30	12.25	12.30	12.50	12.32
pH after reduction to 0.7% available chlorine content with a buffer solution composed of 80 parts sod. carbonate—20 parts sod. bicarbonate—5% solutions						
Test Made						
6/17	10.3	10.5	10.4	10.4	11.1	10.4
6/18	10.3	10.4	10.4	10.4	11.1	10.4
6/19	10.3	10.5	10.3	10.4	11.0	10.4
6/20	10.4	10.6	10.5	10.5	...	10.6
6/23	10.3	10.4	10.3	10.3	...	10.3
6/24	10.2	10.4	10.4	10.4	...	10.4
6/25	10.2	10.4	10.3	10.3	...	10.4
6/30	10.3	10.5	10.4	10.4	...	10.4
7/1	10.3	10.4	10.4	10.4	...	10.4
7/3	10.2	10.4	10.3	10.3	...	10.4
7/7	10.2	10.4	10.3	10.3	...	10.3
7/8	10.2	10.4	10.3	10.3	...	10.3
7/9	10.2	10.3	10.3	10.3	...	10.3
7/10	10.3	10.5	10.4	10.4	...	10.5

Tests made in the Laboratory of the General Dyestuff Corporation, under the supervision of Mrs. Catherine B. Armstrong. Reported 7/21/41.

It was natural to suspect that reduction in available chlorine content during storage and use was principally due to the action of the air that replaced quantities removed from the containers. Table 5 provides some information in respect to the action of trapped air to promote liberation or dissipation of the chlorine. The conditions for these experiments were as follows: A one quart, previously unopened sample of Clorox, a one pint sample of Sterling and a one gallon sample of the Beacon were selected for use. Three fourths of the Clorox and Sterling and one-half of the Beacon sample was removed from the bottles and used to fill several smaller capacity glass stoppered bottles to overflowing and the glass stoppers inserted. These smaller bottles, before use, had been rinsed first with dilute solutions of acid and then carefully rinsed with cold and hot water.

TABLE 5

Dates of Evaluation	*Sept.* 18, 1941		*Oct.* 24, 1941	
	pH	*Chlorine*	*pH*	*Chlorine*
Clorox—sealed sample			10.3	4.55%
original container	10.2	4.91%	10.3	4.53
Sterling—sealed sample			12.2	7.19
original container	12.3	10.25	12.2	7.18
Beacon—sealed sample			12.6	4.52
original container	12.6	4.75	12.6	4.48

The initial pH and chlorine content was determined of the portions left in the original containers. As indicated by the dates at the head of the columns, five weeks elapsed between the dates on which the figures were taken. The figures illustrate that trapped air alone is not the cause of the reduction in chlorine content and that in respect to stability of chlorine content, lower initial quantities are preferable. Some experiments made indicate that carbonate is preferable to the hydroxide to provide stability and especially as the available chlorine content of the solutions is increased.

At this point in the experiments, with careful control of pH, temperature and chlorine content, satisfactory reproducibility had not been achieved. Minor differences existed in identical fabrics tested in solutions prepared from the different samples of hypochlorite. This caused consideration of the possibility of the presence of sodium chloride, perchlorates, metals, organic matter, etc. We were informed by one manufacturer that if temperature was not carefully controlled during manufacture, perchlorates were formed in relatively small but varying quantity and that they were very actively color destructive. Unfortunately, we have not yet found satisfactorily reliable means to detect their presence. Metallic copper, iron, lead, nickel, steel and zinc and their water soluble salts as well as those of aluminum were added to the diluted solutions of the hypochlorites. Only copper and iron were found to exert a visual difference in the degree of color change on test specimens. However, the quantity of these required to cause that degree of change also caused readily observable turbidity or coloration of the solutions, with the result that we were forced to the conclusion that their presence in our experiments was not responsible for the inconsistencies. Sodium chloride next received attention. Table 6 describes the results of pH and available chlorine content determinations of test solutions prepared with and without an added 5 grams per liter of sodium chloride. The first two columns of figures to the left describes the initial pH and chlorine content of the hypochlorites before their reduction to the 0.7 per cent of chlorine required for testing.

Columns 1 to 4 inclusive represent dilutions with the buffer only, and Columns 5 to 8 inclusive identical solutions to which 5 grams per liter sodium chloride was added. The upper or first two rows of figures across the tables were determined immediately after dilution to the strengths desired for test purpose. Identical test specimens were then entered and treated for one hour, following which pH and chlorine determinations were again made. These are the figures in the third and fourth lines. The solutions were then permitted to stand overnight in covered containers. This prevented loss through evaporation and influence by air exposure. In the morning, when the solutions had stood for at least 20 hours after preparation and had been used once for testing, pH and chlorine were again determined and are described in the fifth and sixth lines.

Then another set of identical test specimens were treated in them for one hour as before, following which the pH and chlorine content were again determined. Lines seven and eight are the figures obtained. A sufficient quantity of each test solution was prepared to permit division into three individual parts. One part described as TEST SET

TABLE 6

Experiments to Determine the Effect of Added Sodium Chloride, and of Permitting the Solutions to Stand for 2 and 4 Hours Before Use, and of Reuse After Standing for 20 Hours Between the First and Second Use

Test Set A *Initial*	*pH*	*Cl*	1	2	3	4	5	6	7	8
Clorox	9.21	4.51%	X	..	..	..	X	..	..	..
Dazzle	11.37	4.12	..	X	..	..	..	X	..	..
Rainbow	11.18	4.92	..	..	X	..	..	..	X	..
Whitesail	11.52	4.44	..	..	..	X	..	..	..	X
Buffer 20 parts	....	....	..	..	..	..	..	..	..	..
Sod. bicorbonate	....	....	..	..	..	..	..	..	..	..
80. carbonate	....	....	..	..	..	..	..	..	..	..
NaCL-5 grms./lit.	....	....	..	..	..	..	X	X	X	X
pH after preparation			10.10	10.31	10.25	10.37	10.08	10.27	10.19	10.32
CL after preparation			.69	.70	.60	.76	.67	.67	.63	.77
pH after use			10.10	10.27	10.20	10.32	10.05	10.22	10.17	10.25
CL after use			.64	.64	.60	.73	.64	.66	.60	.73
pH 20 hours after use			10.03	10.18	10.15	10.21	9.98	10.12	10.07	10.14
CL 20 hours after use			.66	.67	.59	.74	.64	.64	.62	.74
pH after reuse for testing			9.82	10.12	10.11	10.22	10.05	10.05	10.18	10.12
CL after reuse for testing			.63	.63	.53	.69	.62	.63	.57	.70
Test Set B Is Identical with Set A Except That the Solutions Were Permitted to Stand for Two Hours Before Use										
pH before use			10.11	10.31	10.22	10.34	10.07	10.25	10.19	10.30
CL before use			.67	.67	.60	.74	.66	.67	.60	.77
pH after use			9.98	10.14	10.10	10.21	9.95	10.11	10.07	10.17
CL after use			.62	.63	.59	.72	.63	.63	.60	.73
pH 20 hours after use			10.01	10.18	10.12	10.21	10.00	10.14	10.10	10.16
CL 20 hours after use			.64	.66	.59	.73	.63	.67	.60	.74
pH after reuse for testing			10.12	10.10	10.09	10.28	10.12	10.04	10.17	10.20
CL after reuse for testing			.59	.60	.60	.69	.60	.62	.56	.70
Test Set C Is Identical with Set A Except That the Solutions Were Permitted to Stand for Four Hours Before Use										
pH before use			10.04	10.26	10.18	10.29	10.02	10.20	10.12	10.23
CL before use			.66	.69	.62	.76	.66	.67	.60	.70
pH after use			9.95	10.17	10.08	10.18	9.92	10.06	10.00	10.09
CL after use			.66	.63	.57	.76	.64	.63	.57	.73
pH 20 hours after use			10.01	10.17	10.10	10.20	9.98	10.10	10.09	10.13
CL 20 hours after use			.63	.64	.59	.73	.64	.64	.60	.74
pH after reuse for testing			10.15	10.25	10.27	10.31	10.17	10.22	10.20	10.28
CL after reuse for testing			.60	.62	.54	.67	.60	.59	.54	.69

A, was used for testing immediately after the pH and chlorine content were determined. The parts described as TEST SET B were permitted to stand for two hours before use for testing purposes and the parts described as TEST SET C were permitted to stand for four hours before use for testing purposes. The liquor volume of each individual part was 400 Ml. Porcelain beakers were the containers and they were not covered except while standing during the night. It is pertinent to mention that after determination of the initial chlorine content, if the solutions are prepared using the quantity required as indicated by calculation, determinations then made will usually show between 3 and 5 per cent less chlorine than anticipated. No effort has as yet been made to determine the cause, nor is it particularly significant for test purposes. Some of the figures in these tables do not conform with that statement; however, that is explained as probably due to the fact that in an effort to conserve time, a slightly different procedure was used for the chlorine determinations and this involved the use of starch iodide test paper as the indicator. It is recognized that this procedure is not as accurate as the methods referred to earlier in this report. However, these experiments, together with another set in which the sodium chloride addition was increased to 20 grams per liter, are believed to have provided acceptable evidence that the presence in the hypochlorite solutions of sodium chloride in varying quantities was not responsible for the inconsistencies we were endeavoring to eliminate.

They also illustrated the rather unexpected, remarkable stability of the buffered solutions, as well as the unexpected, remarkably small reduction in the chlorine content caused by a twice repeated use for testing purposes. This induced another experiment in which two different test solutions were used four times successively for testing purposes. No differences in the degree of color change could be observed between the four tested specimens and relatively small reduction in the initial chlorine content. The test specimens were carefully selected and cut from material known to undergo radical color change in testing.

The presence of organic matter in the form of natural tannins exerts an influence on the degree of color change that is readily apparent. The degree varies on materials colored with the individual dyes and it is separate and distinct from the variations these dyes are known to exhibit. Their presence also exerts an influence on the quantity of available chlorine indicated by the titration method used in these experiments. At first, there is a decrease and on longer standing, overnight, a distinct increase over the initial quantity. This remained consistent in several sets of experiments, however, more experiments are required to permit reliable conclusions. Hardness in water between 200 and 2,000 parts per million is not indicated as causing

more than a negligible difference in the degree of color change.

Any appreciable hardness is quickly apparent by turbidity and precipitation in glassy flake form.

It was natural to recognize that materials treated to exhibit water repellency would not become uniformly and thoroughly saturated with the hypochlorite solution during testing unless some provision was introduced to aid penetration. This can be accomplished through suitable additions to the test liquors or by a previous treatment to make the specimens satisfactorily absorbent. Experiments were made adding some of the well known wetting agents to the test liquors and in quantities in appreciable excess of those required for wetting. Their presence did not appear to exert any influence on the degree of color changes effected in testing. All of the experiments made to provide the information for this report included the use of cotton colored with four different dyes of known variation in sensitivity as well as cloth colored with two combinations of dyes. It is possible, but rather improbable, that all the statements made may not be absolutely accurate for cotton colored with every known vat dye or with combinations of them in every possible variation in respect to relative proportions.

Experiments were made using wetting agents and a neutral soap, each alone in water, and at the temperatures required, to thoroughly wet out and saturate the test specimens. A thorough rinsing in hot water to completely remove these wetting assistants followed before testing. This procedure also had little or no influence on the degree of color change effected in testing. The use of the Launderometer for testing with the agitation that means provides to assist wetting and promote thorough saturation does not appear reliably adequate for all fabrics. Therefore, previous wetting appears necessary and should be established as a provision in testing. If water repellent fabrics require previous wetting and entrance into the test liquors in the wet state, it appears logical in the interests of uniformity and simplicity to establish that condition for all test specimens. The experiments illustrated that specimens placed into the test solutions in the dry state showed a just noticeably greater degree of color change than the identical specimens entered containing their dry weight of water. This statement applies exclusively to dry entered test specimens that become thoroughly saturated during testing.

The degree of color change that occurs during testing on water repellent fabrics is influenced by the absorbency of the specimen.

Consistent reproducibility appears somewhat superior in test specimens when entered wet than when entered dry. This appears an added incentive for previous wetting and wet entrance as a provision in testing procedure.

It is recognized that the chlorine retained in the test specimens is not readily removed by rinsing in cold water. Rinsing in hot water is more effective, however, variations in temperature during hot water rinsing are known to have influenced the degree of color change. To avoid physical damage to the fabric, as well as to avoid color change during drying by means of steam heated cylinders and pressing irons at high temperatures, complete removal of residual chlorine is recognized as a necessity. This can be accomplished through rinsing in liquors containing a variety of known chemical substances. In the laboratory where the majority of the tests were made, treatment for 10 minutes in a 1 per cent solution of sodium thiosulfate at between 70-80° F. has been the means for many years. The personnel of the Philadelphia Depot of the U. S. Army Quartermaster directed attention to the fact that this treatment was not adequate for water repellent fabrics and that the use of a 5 per cent solution did not achieve the desired results. Subsequent experiments confirmed that condition. More experiments indicated that the substitution of a ¼ to ½ per cent solution of sodium bisulfite serves satisfactorily.

Very shortly after the preparation and presentation of this report, the U. S. Army Quartermaster Corps, through Lt. Colonel Vere Painter, established a substitution for the test described in CCC-T-191a, mimeographed copies of which were ordered prepared and distributed about 11/10/41. This new test made a revision of our proposed test advisable because of minor differences in pH and test temperature. These changes the Committee believes can be made without disturbing the value of our test to provide the information for which it is designed.

The following test method is in agreement with the new Q.M.C. test in respect to detail and it represents a revision of the test method proposed when this report was presented at Pinehurst.

A.A.T.C.C. CHLORINE FASTNESS TESTS COMMITTEE

Proposed Tentative Test Method

Procedure in general:

Water—

pH 6.6-7.0 and distilled if preferred.

Buffer—

A mixture composed of

5 parts of a 1 per cent solution of sodium bicarbonate ($NaHCO_3$)*

95 parts of a 5 per cent solution of sodium carbonate (Na_2CO_3)*

Chlorine—

0.3-0.2-0.1-.01 per cent solutions of sodium hypochlorite (NaOCl)

Liquor volume—

50 times the dry weight of the test specimen.

pH—11 plus or minus 0.2

Temperature—80° F. plus or minus 5

Test time—one hour immersion.

Test specimen—Not less than 2 grams in dry weight, to be thoroughly wet out previous to testing and to be entered into the test liquor in the wet state and containing approximately its dry weight of water.

Procedure in detail—pertinent explanatory notes follow

Weigh the test specimens, wet them thoroughly and remove surplus liquor.

Prepare the test liquor by dilution of the sodium hypochlorite with the buffer to the strength required.

Enter the test specimen and treat for 1 hour immersed under the surface of the liquor, with occasional stirring, agitation or movement. The container, preferably of porcelain to prevent possible influence of variations in light intensity, may be covered, if desired.

Drain off the test liquor or remove the test specimen and immediately place it into cold, running, tap water for five minutes. Then treat it for 10 minutes in a 0.25 per cent solution of anhydrous, dry sodium bisulfite ($NaHSO_3$)* at a temperature between 75 and 85° F. Then treat for five minutes in cold, running, tap water. Remove the surplus water and dry between white cotton with an iron heated to not above 150° C.

Explanatory Notes:

Water—

White it is recognized that distilled water is usually prescribed for testing purposes, many experiments made indicate that ordinary tap, drinking water is satisfactorily useful for the present purpose. The latter may be preferable because the pH of tap, drinking water in several of the larger cities is found to be between 6.8 and 7.0, whereas, the pH of distilled water found in use in a number of laboratories was found to be between 5.6 and 7.2.

Sodium Hypochlorite—

The pH values and the available chlorine content of a large number of trade named products available in chain groceries for home laundry use have been examined. The pH varies between 9.8 and 12.8 and the chlorine between 4 and 6 per cent. The trade names of some of these products are Beacon, Clorox, Dazzle, Emerald, Javex, Rainbow and Whitesail. Their labels usually describe their active NaOCl percentage when bottled, however, these figures are not reliable and their actual content should be determined before they are used for test purposes. Procedure for determining the chlorine content is described in the A.A.T.C.C. 1941 Year Book, Page 345 and in Federal Specification O-B-441a, procurable from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. at a cost of five cents per copy.

Any of these trade named products are suitable for test use and in addition the Committee plans to have made available in the near future a sodium hypochlorite solution prepared to conform to specifications it will formulate.

****Buffer—**

Any hypochlorite solution with an initial pH between 11.2 and 12.8 will be buffered within the 10.8 and 11.2 desired if diluted to the chlorine content required with the buffer mixture already described. However, if the initial pH is between 9.6 and 11.2, 0.5 gram sodium hydroxide, caustic soda (NaOH) technical or C.P. quality should first be added to each pint or one-half liter, and preferably in the form of a 10 per cent solution. This will raise the pH to within the range which the buffer will control. This addition of caustic soda will exert little or no effect on the stability of the hypochlorite solution. Storage in colored bottles, tightly stoppered, in a cool place, protected from strong light, aids stability.

Liquor Volume—

The U. S. Army Quartermaster, Philadelphia Depot have, for some time, and will continue to use the Launderometer for testing. Its use is not a definite necessity, however, it does assist uniform penetration and action of the test liquor and thus aids consistent reproducibility. Liquor volumes permissible for use in the pint jars, standard Launderometer equipment, have been set for between 100 and 300 Ml., thus limiting the test specimen dry weight to between 2 and 6 grams.

*The figures are for what is generally described as technical quality, anhydrous form.

**For the experiments that provided the information for the formulation of this test procedure, the Beckman pH Meter—Model G and its Electrode—Type E—Glass High pH, was used for the pH measurements above 9. It was accepted as adequate for this purpose only after a series of experiments had demonstrated that sodium hydroxide and carbonate solutions in varying concentrations could be consistently arranged in the order of their known content as a result of pH measurements with this apparatus. The A.A.T.C.C. Year Book and Federal Specification O-B-441a, describe procedure to determine free alkali in hypochlorite solutions.

For those not equipped with pH meters, the following figures may aid conversion to approximate pH of known alkali content determined by titration methods.

Per cent	*Sodium hydroxide NaOH (caustic soda)* pH	*Sodium carbonate Na_2CO_3 (soda ash-anhydrous)* pH	*Sod. bicarbonate $NaHCO_3$ (anhydrous)* pH
0.01	10.90	9.6	7.7
0.05	12.00	10.1	8.1
0.1	12.30	10.5	8.1
0.2	12.60	10.6	8.1
0.5	12.80	10.8	8.1
1.0	13.00	11.1	8.0
2.0	13.00+	11.2	7.8
5.0		11.2	7.6

The pH of the buffer solution is approximately 11.0.

It is realized that these figures may not be absolutely accurate, however, they should serve to indicate if the hypochlorite is within the range that will be satisfactorily controlled to between the 10.8-11.2 desired or whether the 0.5 gram caustic soda should be added before reduction to the chlorine content required for test purpose. The figures above are much more liable to be under than over the correct pH, however, experience indicates that error in these figures is not liable to be greater than 0.2 unit.

Until the Committee can make available a hypochlorite solution buffered to within the desired range, it is suggested that those who depend upon a trade named purchased product and wish to avoid the necessity of free alkali determinations, use Clorox and add to each pint 0.5 gram caustic soda in solution form, then determine the chlorine content and then dilute it to the chlorine content desired for testing with the buffer already described. This procedure will provide a pH between 10.8 and 11.2. We are informed that in the near future, the maximum available chlorine content of all the trade named products for home laundry use will be 3.0 per cent to comply with a recently issued Federal order making that condition mandatory.

pH and Temperature—

Many tests have demonstrated that reproducibility is superior at the pH adopted than at lower values and because the pH values of hypochlorite solutions in use for practical plant processing are, in general, slightly above 11.0, the pH established should be acceptable.

The temperature was established because it was believed to be a reasonable average and one that could be maintained either in the Launderometer, or in other vessels by placing them into water heated to maintain that temperature.

Established testing procedure at the Philadelphia Depot of the U. S. Army Quartermaster Corps also influenced the pH and temperature provisions. Consideration for preference and acceptance by this group is appropriate, being based on wide experience and because the test is of principal interest to those processing material to meet the color fastness requirements described in Federal Specification CCC-T-191a. These provisions were also found suitable in respect to the tests described in Commercial Standard CS59-41.

This test has little, if any, interest for the consumer trade and it has lost much of its importance for the processor and convertor because the peroxides have generally replaced hypochlorite for bleaching materials containing colored threads and patterns, such as handkerchiefs, napkins, table and wash cloths, towels, etc.

Test Time—

The one hour period is established in already existing tests and the total immersion represents majority preference as ascertained by answers to a questionnaire.

Test Specimens—

The weights, between 2 and 6 grams, were established because it was found that they represented surface area or lineal measurements that could be readily handled to produce uniform results and be of a size convenient for comparison with the original or control.

If the quantity of material available for testing weighs less than 2 grams, it is suggested to make up the weight difference with other available cloth, preferably the Standards to be established in the near future, or with thoroughly boiled-out, unbleached muslin.

Preparation of the Test Specimens—

Test specimens of water repellent fabrics must be entered into the test solutions thoroughly wet out to ensure uniform penetration and action of the test liquor. Thorough wetting is accomplished almost instantaneously by immersion in a 0.5 per cent neutral soap solution at room temperature. Removal of residual soap is not necessary and should not be attempted because absorbency is lost with soap removal. After saturation with the soap solution, merely pass the cloth in flat form through a rubber roll hand wringer, with the pressure set to permit the cloth to retain at least its dry weight of the soap solution. Do not use paper towels or any other absorbent material as an aid to remove surplus soap solution because this also causes loss of the cloth's absorbency. A plausible explanation for this condition may be that the soap solution is held between the threads and when the saturated cloth is subjected to pressure held between any dry absorbent material, the latter is pressed between the threads and thus removes the soap. This it is realized is equivalent to an admission that the soap solution may not actually penetrate through the threads and that may be a fact. However, by the proposed means, the cloth will immediately sink below the surface of room temperature water. It is also established that the small quantity of soap retained in the cloth does not influence the color change effected in testing to more than a negligible degree. Obviously, for this type of cloth, the Launderometer is an ideal means for testing because of the agitation it provides. However, this agitation alone is not sufficient to cause thorough wetting or saturation during the hour treatment if the test specimen is entered into the test liquor in the dry state. To aid consistent uniformity in test results, it is recommended that all samples be wet out before testing. This is established procedure at the Philadelphia Depot of the U. S. Army Quartermaster Corps. Plain and Sanforized cotton will wet out readily in hot water. This should be followed by rinsing in cold water to reduce the temperature and then passage in flat form through a rubber roll hand wringer.

Removal of Residual Chlorine—

It is recognized that the chlorine retained in the test specimens is not readily removed by rinsing in cold water. Rinsing in hot water is more effective, however, variations in temperature during hot water rinsing are known to have influenced the degree of color change. To avoid physical damage to the fabric as well as to avoid color change during drying by means of steam heated cylinders and pressing irons at high temperatures, complete removal of residual chlorine is recognized as a necessity. This can be accomplished through rinsing in liquors containing a variety of known chemical substances. In the laboratory, where the majority of the tests were made, treatment for 10 minutes in a 1 per cent solution of sodium thiosulfate at between 70-80° F. has been the means for many years. The personnel of the Philadelphia Depot of the U. S. Army Quartermaster directed attention to the fact that this treatment was not adequate for water repellent fabrics and that the use of a 5 per cent solution did not achieve the desired results. Subsequent experiments confirmed that condition. More experiments indicated that the substitution of a one-quarter to one-half per cent solution of sodium bisulfite serves satisfactorily.

Drying after Testing—

The temperature and conditions established for drying are believed to be adequate for convenience and to be sufficiently low to prevent scorching of the material as well as to prevent color change.

Intersectional Contest—

The Textile Chemist Meets

NATIONAL DEFENSE EMERGENCY

Presented by Thomas H. Roberts for the Rhode Island Section

FOR more than two years, we have been witnessing throughout the world a period of unprecedented strife and turmoil. During this time, we have seen the beginning of the Battles of Poland, Holland, Belgium, and France with their disastrous culmination. Today, we find the Battle of Russia and the Battle of the Atlantic waging with increasing fury and intensity on our very threshold and drawing us closer and closer to the whirlpool of strife and destruction.

During this period, there has been another battle taking place right in our midst and it, too, is growing day by day in fury and in intensity. The battle, to which I refer, might well be called, "The Battle of Substitutes." All industry throughout our land has been drawn into this battle, as it has labored valiantly to produce the materials required for the successful prosecution of our National Defense Program. The enormous demand for materials of all kinds and the disruption or total failure of the source of supply of many of them, brought about by war activities, has made the question of finding suitable substitutes a vital necessity. Probably no industry consumes a wider variety of materials in its processes than the textile industry. Faced with an unprecedented demand for its products, and, at the same time, a drastic curtailment in the supply of many of these essential materials, it has appealed to its chemists to find the ways and means to "carry on." It is the purpose of this paper to discuss, insofar as the time available will permit, some of the methods by which this appeal has been met through the co-operative efforts of chemists in every branch of the textile industry. The following discussion will deal primarily with methods of meeting problems arising from the shortage of raw materials used in the production of textile products.

STARCHES, GUMS, AND ALLIED MATERIALS

A large proportion of the starches and natural gums used in the textile industry has been imported from foreign sources due either to the fact that they cannot be produced in our climate or because they are produced at lower cost than we could produce them here.

Tapioca and Sago Flours—Imported largely from the Dutch East Indies, these are the two principal imported starches used in large quantities by the textile trade, which, due to present conditions, might be hard to obtain. These starches and, of course, the gums and dextrines manufactured from them, are the ones which will have to be substituted by domestic starches, such as, corn, potato, and wheat.

While, in some cases, price might have been the controlling factor in their use in preference to domestic starches, it is admitted that the properties of flow and adhesiveness that pastes made from these starches exhibit, and the strength and plastic qualities of the films formed on drying have made these starches more desirable and more advantageous to use for many purposes than materials of domestic origin independently of price consideration.

Tapioca Flour and Sago Flour, and products made from them, are used in the textile field for three main purposes; by the weaving mills for warp sizing; by the finishing plant for finishing, to impart body, hand and lustre to the cloth so it will be attractive to the buyer; by the printing establishments as a thickener for the colors so they can be applied properly to the cloth.

In deciding which of the many starches or their derivatives should be used for any one of these purposes, main consideration of course, must be given, first, to the viscosity and flow properties of the paste. These flow characteristics differ substantially with each type of starch and, when plotted, no two curves are alike. Chart No. 1 shows a comparison of these characteristics of the chief imported and domestic starches as measured by means of the consistometer.*

While this fact is well-known, the reasons for it are not as yet well understood. Fortunately, we can, by chemical treatment, and sometimes even by a simple change in method of cooking or change in rate of agitation, modify these flow properties and bring them more in harmony with the requirements of the operation at hand. Domestic starches, such as, corn, wheat, and potato, so treated, can be made to approximate the flow properties of tapioca and sago.

Chart No. 2 shows the effect of variations in cooking procedure on flow properties of tapioca flour. Such variations have equally marked affect on corn, wheat, and potato starches.

A comparison of the curves, representing several modifications of cornstarch, as shown in Chart No. 3, with those of the previous chart shows how closely the characteristics indicated in the latter may be approximated.

*Caesar & Moor, Ind. Eng. Chem., 27, 1447 (1935).

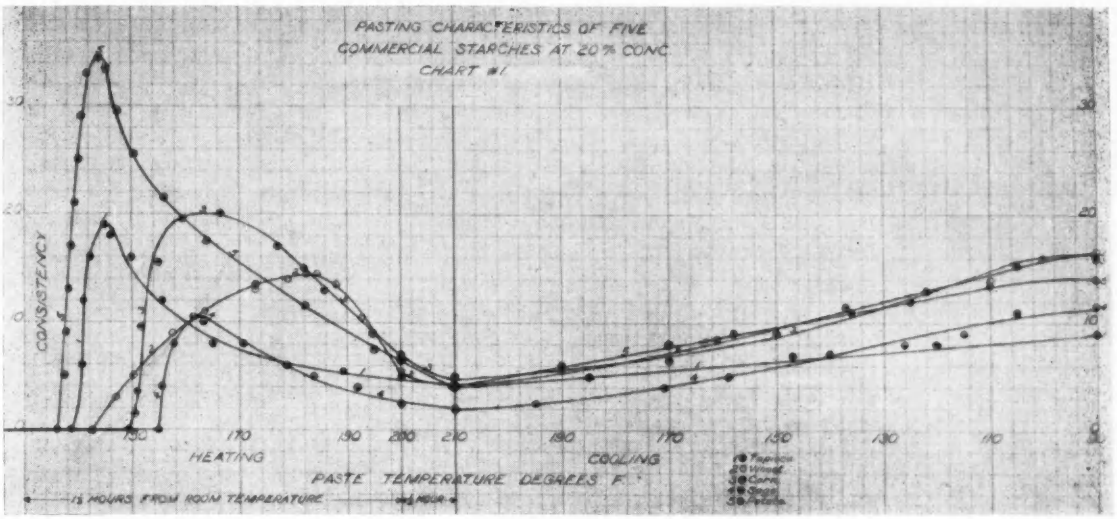


Chart No. 1

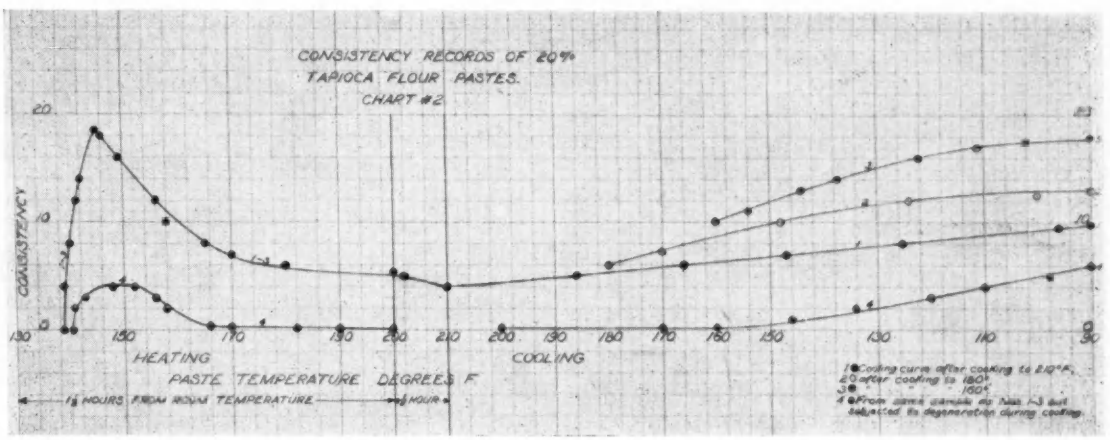

CONSISTENCY RECORDS OF 20%
TAPIOCA FLOUR PASTES.
CHART #2
CONSISTENCY
HEATING
COOLING
PASTE TEMPERATURE DEGREES F
1½ HOURS FROM ROOM TEMPERATURE
½ HOUR
1 Cooling curve after cooking to 210°F.
2 After cooking to 180°
3 " " 150°
4 From same sample as Nos. 1-3 but subjected to degeneration during cooling

Chart No. 2

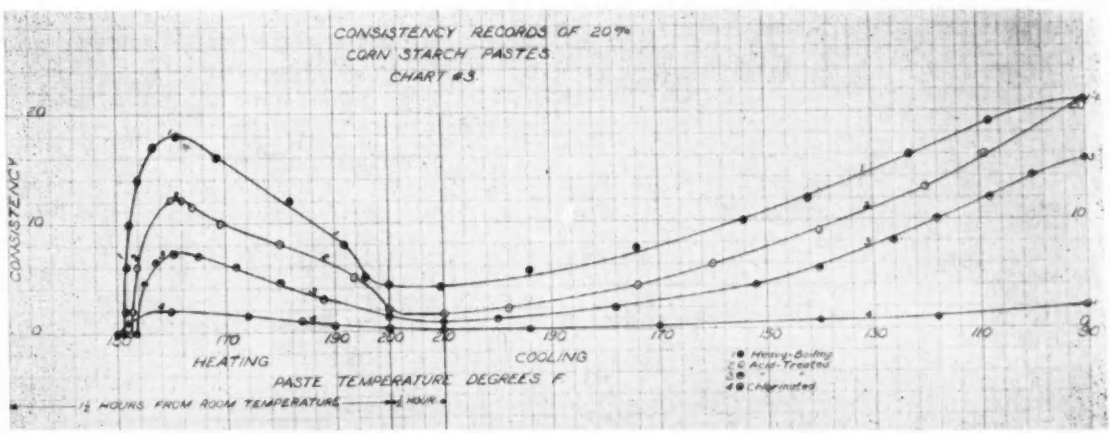


Chart No. 3

The next item of importance in substituting one starch for the other is the strength of the dried film. This is especially important in evaluating a starch for warp sizing and stiffening properties. Unfortunately, very little can be done by chemical or mechanical treatment to increase the range inherent in the natural product, while a lot can be done to destroy this valuable property by improper care in cooking and handling. On the other hand, the degree of variation in strength is not quite as wide and marked as that in the viscosity field, and the gap can be abridged more easily by the use of suitable binding materials.

The third important property that requires careful consideration is the plastic and related qualities of the dried films. In this regard, starches differ as markedly as in viscosity, if not more so. Some starches, like corn, form brittle and cracky films, some, tough and leathery like sago. The determination of this property is of paramount importance in the finishing of cloth as it is the deciding factor in imparting to the cloth the proper hand and lustre, and this is the field in which greater difficulty may be encountered in substituting domestic products for gums and dextrines made from imported starches. The addition of plasticizing and softening agents will give the desired results in some cases. Suitable materials of this type include sulphonated oils and fats, glycerine and related products, glucose, cationic softeners, glues and gelatines. In other cases, the desired result may be obtained by special chemical treatment of the starch by methods, such as, chlorination, acetylation, and oxidation. By taking full advantage of these possibilities, we will be able to operate successfully in spite of the possible elimination of imported supplies.

Gum Arabic—Its supply largely curtailed by war activities in the countries from which it is imported, this gum is widely used in the textile industry as an adhesive in the processing of thread and fabrics, and as finishing ingredient for a wide variety of fabrics to produce clear, crisp finishes with varying degrees of stiffness.

For many purposes, its adhesive properties may be duplicated to a large extent by the use of suitably prepared dextrines. The adhesive properties of the latter may be further improved, in many cases, by the addition of plasticizers, such as, glycerine or glue, or by the use of resins, either in water soluble or dispersed form.

In the production of finishes having good transparency and the characteristic crisp hand imparted by Gum Arabic, excellent results may be obtained by the use of gums produced from domestic starches by acid conversion or by chlorination.

Gum Tragacanth—This unique gum, the importation of which has also been disrupted by war activities, has many uses in textile printing operations. Starch gums, alginates and soluble cellulose ethers, such as methyl cellulose, have been found satisfactory as replacements for many of these uses.

Locust Bean or Carob Gum—Largely obtained from countries bordering on the Mediterranean and, now, practically unobtainable, this product was widely used as printing thickener, and as binding agent in warp sizing and finishing. For printing naphthol colors with Fast Color Salts or diazotized bases, we find both starch gum and water-soluble cellulose derivatives, providing excellent replacements. As a binder for warp sizing, recently developed water-soluble resins as well as a number of types of synthetic resin dispersions are producing results surpassing the natural product.

Albumen—Another material that already is very scarce and very high in price and which has been used in the textile field in large quantities is albumen. The main use of this material is in printing, for white pigment discharges. Its main advantages are its property of coagulating and becoming insoluble at relatively low temperatures and its resistance to the action of alkali and hydrosulphite solutions. Special synthetic resin compositions of the thermosetting order have been developed for this purpose, and these are proving so successful that we believe that even when albumen again becomes plentiful and cheap, these materials will hold their own, as they have two decided advantages over albumen, ease of preparation and freedom from decomposition.

Gelatine—With supplies restricted to domestic production and with enormously increased demand for both the industrial and food types, we are facing serious curtailment of supplies of this commodity available for textile use. Used principally for sizing or slashing rayon yarns, it has been considered practically essential for the production of filament rayon fabrics. However, successful results can be obtained by use of suitably dextrinized starches in conjunction with properly selected lubricating and softening agents. The following are examples of sizing formulas of this type:

Formula No. 1	*Formula No. 2*
For sizing 150 denier, 40 filament bright yarn for twill weave, 72 x 46 construction	For sizing 100 denier, 60 filament pigmented yarn for 92 x 62 taffeta.
45 lbs. Dextrine Sizing Gum	50 lbs. Dextrine Sizing Gum
3 lbs. Resin Binder	3 lbs. Resin Binder
100 gallons	100 gallons
Cook to 195° F., and run at 165° F.	Cook to 195° F., and run at 165° F.
This warp was run on plain Draper loom, 170 picks per minute with 4 banks of drop wires with 3 harnesses.	This warp was run on plain loom with 4 harnesses.

While there is a considerable amount of prejudice in favor of gelatine for filament rayon sizing, it should be emphasized that dextrine sizes are equally as suitable for many styles and may be used to conserve gelatine for use where it is indispensable.

Other materials offered as replacements for gelatine include casein derivatives, polyvinyl alcohols, water-soluble cellulose derivatives, and resins.

OILS, FATS, AND WAXES

Probably, no group of raw materials has been more profoundly affected by world conditions than that com-

prising the oils, fats, and waxes commonly used in processing and finishing operations on textiles. Either in their original form or after sulfonation or saponification, they are the basis of manifold types of scouring, dyeing, and finishing agents.

Among this group, we find many imported materials, the supply of which has been sharply curtailed or eliminated altogether by blockade, shortage of transportation, or economic measures imposed by existing world conditions. Of chief interest to the textile industry in this group are such products as olive, teaseed, palm, and cocoanut oils, and Japan and Carnauba wax, all of these have played an important role as the basis of many types of processing and finishing compounds.

Olive Oil—Probably the first of this group to be affected, olive oil, because of its manifold uses, has been the object of much effort on the part of chemists in the industry to find suitable means of replacement. For a short period, teaseed oil was a satisfactory substitute for many purposes, but with the curtailment of Chinese exports, it soon became necessary to look for other sources of materials. A survey of domestic oils produced in sufficient quantity to insure adequate supply indicated corn oil, cottonseed oil, peanut oil, and soybean oil as possibilities from the standpoint of availability and of physical and chemical characteristics.

For producing sulfated oils, in which form olive oil was very widely used, the iodine value of the raw oil has been found to be a good indication of its suitability. The iodine value, also, provides an indication of the type of oil from the standpoint of its resistance to oxidation and rancidity. Low iodine numbers indicate resistance to sulfation processes of the ordinary type, but good resistance to oxidation and rancidity, while increasing iodine values are accompanied by greater ease of sulfation with high iodine values indicating oils of the unsaturated or drying type which readily develop rancidity unless modified by chemical processing.

By blending the most suitable of these materials, modifying the methods of sulfation, and developing improved methods of stabilizing the finished products, very satisfactory oils for sizing, dyeing, and finishing purposes have been developed.

However, probably the most outstanding contribution to our emancipation from the domination of imported oils in the textile field has been the development of synthetic or, more properly speaking, synthesized oils equal or superior in all essential characteristics to their natural prototypes. These new synthesized oils are the result of greatly improved technique in the separation and purification of fatty acids obtained from naturally occurring fats and oils. Described briefly, the process consists in splitting animal or vegetable oils from any available source forming the corresponding fatty acid mixture and glycerine. The fatty acids are separated by fractional distillation under high vacuum into the desired components. These are converted back to the glycerol esters, thereby producing a product to meet required specifications.

By combining the process of hydrogenation with this process of separating the fatty acids of the naturally occurring oils and reconstructing oils having the desired characteristics, it is possible to duplicate all of the essential characteristics of many imported natural oils, thereby rendering this country independent of foreign sources of these essential materials, for industrial purposes.

In the following table, Synthesized Oil A and Synthesized Oil B represent commercial products manufactured by methods just outlined and offered as replacements for olive and teaseed oils.

TABLE I

Type of Oil	*F.F.A.*	*Av. Iodine No.*	*Av. Sap. No.*	*Unsap. No.*	*Titer*
Olive	3-5%	83.5	191.	1.-1.4%	18-23°C.
Teaseed	3-5	88	194.	1.-1.5	13-14.5°C.
Peanut	1.5	94.	193.	0.25	28-30°C.
Corn	3-5	117.	190.	1.3-2.0	18-20°C.
Cottonseed	3-5	109.5	193.8	0.7-1.5	32-38°C.
Soybean	3.5	128	189.5	0.3-0.6	.....
Synthesized Oil A	3-5	88	190	3.3	9-12°C.
Synthesized Oil B	3-4	86	190	1.7	.....

In addition to its use for sulfation purposes, olive oil has been widely used, either raw or emulsified, as a lubricant in the spinning of worsted yarn for which purpose it was considered indispensable by many manufacturers. Synthesized oils have been found equally as efficient as the natural product in every way and to have certain advantages due to absence of impurities found in the latter and to the greater uniformity made possible by strict chemical control. Fatty acid esters, other than the glycerol esters, are being marketed as suitable lubricants in worsted processing to replace olive oil. The National Association of Wool Manufacturers promoted a long study of this question and has set up an alternative for olive oil, which is a blend of mineral and cocoanut oils, for which they have published specifications.

CATIONIC AND SUBSTANTIVE SOFTENERS

The recent sharp increase in cost of oils and fats of all types that enter into the production of textile products has opened up the possibilities of these comparatively recently developed products. Generally speaking, these are amino condensation products containing long chain fatty acid residues and exhibit considerable affinity for the surface of many textile fibers, particularly cotton and rayon.

Because of their remarkable softening power in comparison to softeners of the sulfated oil types, they may be used in very low concentrations with consequent conservation of raw materials and saving in costs. Experience has shown that in many cases, the substantive type of softeners will give excellent results when used in a ratio as low as one pound to five pounds sulfated oil.

TALL OIL*

A by-product of the Kraft paper industry, the potential supply of this product is very large. It is an excellent substitute for low titer fatty acids in the production of soaps, detergents, and emulsifiers for processing textiles. Development of methods for sulfating this refined material has materially widened its usefulness.

JAPAN WAX

With imports hampered by trade restrictions with Japan, this important ingredient in sizing and finishing formulas may soon become unobtainable. By the hydrogenation of selected fats, products showing many of the characteristics of Japan wax may be obtained. Further blending with domestic waxes and resins has produced suitable replacement materials for many purposes. Recently, there have appeared on the market waxes from South America which appear to have many of the characteristics of Japan wax.

CHEMICALS AND DYES

Acetic Acid—Enormous defense demands for use in production of solvents, plastics, and plasticizers have created an acute shortage of this material. The use of such substitutes, as formic and lactic acids, has given little relief due to limited amounts available. Acetic acid produced by fermentation, and subsequently refined and concentrated, although still much lower in acid content than the usual commercial grades produced by synthetic methods or from wood distillation, will meet many requirements where the acid is to be used in dilute form.

Specific examples of methods of meeting the acetic acid shortage include the following:

(a) Acid Ageing of Textile Prints:
The supply of commercial acetic may be extended by admixture with formic acid as already practiced in many plants. This procedure will also permit the use of considerable proportion of the low strength acid above mentioned.

By improved methods of atomized injection of the acid into the ageing apparatus, the latter may be substituted entirely in place of acids of usual strength.

(b) Dyeing of Raw Stock, Shoddy, Tops and Slubbing: In addition to products previously mentioned, the use of ammonium sulfate is yielding excellent results for this type of work. In some instances, the dyeing is accomplished by simply replacing the acetic acid by suitable amounts of ammonium sulfate, in others the addition of mineral acid gives excellent results. The following formula has been found satisfactory in practical use:

40 gallons water
15 pounds ammonium sulfate
25 pounds sulfuric acid 66° Bé.

50 gallons

Add acid *slowly* with good agitation to water in which ammonium sulfate has previously been dissolved. Use pound for pound in place of formic or 56 per cent acetic acid.

(c) Dyeing of Woolen and Worsted Piece Goods: The refined fermentation product meets all requirements for this work. Lactic acid and formic acid are also suitable although, as stated above, the supply is limited.

*Vilbrandt, Chapman, Crockin, Ind. Chem. Eng., 33, 197 (1941).

FORMALDEHYDE

Indications are that the increasing diversion of equipment and raw material will increase the difficulty of obtaining this product for textile purposes. As a component in resins used for anti-crease processing, it is apparently irreplaceable. However, in the aftertreatment of dyed fabrics to obtained increased fastness properties, other methods may be used, thereby conserving its use for more essential purposes. A study has been made of a number of aftertreating agents to determine their suitability for aftertreating fabrics dyed with direct colors which are normally aftertreated with formaldehyde. Table II shows a comparison of various aftertreating agents from standpoint of wash fastness and dischargeability, the two most important requirements of this type of work. Changes in shade are indicated, also, but it is felt that allowance for them may be made in the dyeing process. Tests were conducted on a number of the dyestuffs commonly used for this type of work by treating samples of goods in process as indicated under heading, Formula. Results were checked under usual plant conditions.

Bichromate of Soda—One of the first chemicals to be put on a priority basis, sodium bichromate, will probably remain available for essential defense purposes where suitable preference ratings are obtainable. However, one of its many uses in textile processing is for the oxidation of vat colors in the process of dyeing or printing of rayon and cotton yarn and piece goods. For some of these purposes, it may be replaced by peroxides and perborates. Unfortunately, there is at the present time a serious shortage of these materials, also.

In the oxidation or development of vat dye prints, subsequent to the ageing process, the consumption of bichromate may be reduced or even eliminated by subjecting the prints after ageing to a prolonged open width cold water washing operation during which the goods are given as much aeriation as possible by passing over skieing rolls and subjecting to repeated cold water sprays. Colors that reoxidize slowly may then be finished off with the usual bichromate oxidation, if necessary.

In the dyeing of vat colors by jig method, the use of bichromate for oxidizing the reduced or lenco color may be eliminated in most instances by the following procedure:

TABLE II

Formula[1]	*Wash Fastness*	*Dischargeability*	*Remarks*
Formaldehyde standard 4% formaldehyde 20 minutes @ 140° F.	Standard	Standard	The formaldehyde treated samples were taken as the standard for comparison.
2% aluminum formate solution 16.5° Bé. 20 minutes @ 120° F.[2]	Improved, but lower than standard.	Equal to standard.	Produces slight shade changes on some colors which may be compensated for in dyeing.
½% copper sulfate 20 minutes @ 120° F.	Excellent, better than standard in many instances.	Very poor, not suitable for discharge work.	Greatly improved wash fastness may be obtained on selected colors. Many colors badly altered in shade.
1¼% bichromate of soda ¾% aluminum sulfate 2% acetic acid 28% 20 minutes @ 120° F.	Improved, but somewhat below standard.	Inferior to standard.	Shade changed on some colors. This formula has proved useful in practice for producing plain shades with selected colors.
3% lignin sulfate 30° Bé.[3] 20 minutes @ 120° F.	Slightly inferior to standard.	Equal to standard.	Slight shade changes on some colors. Adjustments may be made for these in dyeing. Tests indicate excellent possibilities for this material on plain dyes and prints.

[1]All formulas based on weight of goods.
[2]Aluminum acetate or basic aluminum sulfate will produce similar results.
[3]Derived from sulfite waste liquor.

After dyeing the jig roll with reduced vat, using from 4 to 8 ends as needed, the dye bath is dropped and given two ends in color or lukewarm solution of 10-15 pounds. Bicarbonate of soda in 30 gallons water. This procedure reduces the high alkalinity of the dye vat and reduces the solubility of the leuco compound, thereby preventing loss of color and marking off in the following operations. The goods are then batched up through running cold water, run off into boxes, and then oxidized with air by running in plentiful supply of cold water in continuous rope form. They are then squeezed, opened and dried.

Chlorine—Although indispensable for the production of white goods, printed goods with large proportion of white ground, or for the production of extremely bright or pastel shades, chlorine may be conserved, in many cases, by improved methods of scouring, boiling-off, and kier-boiling the grey goods. It is true that we can substitute the peroxide and perborate methods in place of chlorine, but it is evident that these materials are in much the same boat from the standpoint of availability. Kier-boiling methods which are normally suitable where goods are subsequently to be bleached may be improved to such an extent that the goods will come from the kier with the equivalent of a three-quarter bleach or better and may then go directly to the dyeing or printing process.

This can be accomplished in many instances by simply increasing the amounts of chemicals and kier assistants to produce adequate detergency and prevent redepositing of the materials removed from the cloth. In some instances, the judicious choice of a suitable kier assistant will overcome local deficiencies of water supply or equipment and produce the desired result. For more difficult cases, it has been found that the kier boil may be followed by an open boil, without turning the kier, using soda ash or other alkalies and properly chosen assistants.

Dyestuffs—It is impossible in the brief scope of this paper to do more than touch briefly on a few points in connection with these important materials. We all know that for the most part, the specification for military and defense fabrics require a very high degree of fastness, particularly to light and washing. In the field of cotton defense fabrics, this has meant that the manufacturer is practically confined to the use of the vat dyestuffs. The enormous demand for suitable vat dyes has created a shortage which seems to be growing more acute.

It would seem that many defense fabrics do not require the all-around fastness properties that necessitate the use of vat colors and that by a judicious alteration of specifications, other types of colors, such as the more easily manufactured sulfur group, could be used in many instances to get adequate results.

Mineral dyed fabrics, having excellent fastness to light, water and exposure, have an important role in the military and defense scheme. However, shortage of essential ingredients entering into the production of this type as well as lack of adequate plant facilities are drawbacks to greater production.

A comparatively recent development in the printing and coloring of the textile fabrics is the so-called pigment process. In this process resins in various emulsion or dispersion forms are used as binders for the fixation of finely divided pigments. Applied by standard plant methods, this process requires only such types of equipment as may be found in practically all dyeing and finishing plants. Production of shades having extreme fastness to light, up and exceeding 300 Fade-Ometer hours in many cases, with high resistance to water and to exposure to weather is possible by this means. Research is develop-

(Concluded on page 700)

Intersectional Contest—

Relative Exhaustion of VAT COLORS in the Pad Pigment Method of Jig Dyeing

Presented by C. Norris Rabold for the Piedmont Section

THE purpose of this paper is to present a simple method of evaluating the exhaustion rates of vat colors, either singly, or in combination, and to give our observations on various colors and combinations as a result of making such tests.

For several years the need for a method whereby a dyer in a textile plant could easily determine the exhaustion rates of the various vat colors he was using, has been apparent to the speaker. On checking up with various dyestuff companies, we found that there was no organized information on this subject. Most of the companies had gone into the matter of exhaustion rates on directs and sulfurs rather thoroughly and also had some data on vat colors for continuous machine work, but little information could be obtained on pad pigment dyeing.

Even though the dyestuff companies had ample information on pad jig work, it would be very difficult for an individual plant to make use of it, since most plants buy their colors from several different sources. It would mean trying to interpret varying methods of testing and rating in terms of a particular jig procedure. We believe the only way whereby exhaust tests would be of value to any plant would be for this plant to run such tests themselves, performing the test in such a way that it would be related to their own method of dyeing.

A study of exhaustion rates in itself is not a cure-all for all the troubles that may befall a dye house, for many of these are due to circumstances beyond the dye house's control, but we have proven in actual practice that some thought given to the exhaustion rates of vat colors will result in the following benefits:

1. Better matching of shades and better uniformity of shade from lot to lot.
2. Decrease in the number of shades within a given lot.
3. Virtual elimination of end to end taper in jig rolls, and as far as the dye house is concerned, greatly decreased taper on end cuts.

It is unnecessary to point out that these advantages produce a decrease in yardage to be rehandled, with a decrease in cost of production. This results in increased dye house efficiency, for jigs tied up with goods being rehandled are not producing.

The exhaustion test as here described is not original with us but is an adaptation of the "step" method long used by dyestuff companies in evaluating the speed of exhaustion of direct and sulfur colors. It recommends itself because of its simplicity, for it requires no expert chemist to make it, nor does it require any more complicated apparatus than a balance, a beaker, a thermometer and a stirring rod.

The procedure is as follows:

Dye Bath:

Take 10 cc. of pad color and dilute to 400 cc.
Add 4 grams solid caustic soda.
Add 4 grams sodium hydro-sulfite.
Add 5 grams common salt.
Bring to desired dyeing temperature.

Previous to making up the dye bath, the operator cuts eight 5 gram patches of the cloth to be dyed which are wet out so that when added to the dye bath, they will replace liquor lost by patches being taken out. To run the test, the operator places Patch No. 1 in the dye bath and allows it to remain there five minutes, then it is withdrawn, allowed to drain back surface liquid, rinsed quickly in a large volume of cold water and placed in the oxidizing bath. Upon removal of the first patch, a second patch is placed in the dye bath and this process is repeated until all eight patches have been dyed. After drying, the patches are arranged in order and by visual observation, the operator determines the rate of exhaustion. A person can readily see that this test is one easily performed by an operator with little skill, provided he gives reasonably close attention to his times, temperatures and concentrations.

Now undoubtedly, there will be some questions as regards the relative concentrations and times employed. First of all, the concentration of color was set at 10 cc.-400 cc., for we found that this concentration gave us a shade equal in depth to a straight pad pigment dyeing. The quantity of caustic soda and hydro used was set arbitrarily, as it was found ample to keep most any concentration of color in reduction. We experimented using no salt, as well as different quantities of salt in setting up the test but found that five grams more nearly duplicated the

rate of exhaustion found on the jigs. The time of exhaustion can and should be varied and should be approximately the same for each patch as the time it takes for a jig end. The number of patches run (8) should be more than enough to take care of the normal length of time a jig roll is being dyed, but the several extra patches over the usual number of jig ends are made so as to more nearly exhaust the color in the bath.

For our records, we have exhausted all of our vat colors at two temperatures, 120° F. and 140° F., and have made these exhausts in two concentrations, 0.5 oz./gal. pad color and 6.0 oz./gal. pad color. We have gone over these exhaust tests very carefully and have tabulated the results in terms of fast, medium and slow, with various notations as to an individual color's peculiarities. This chart is consulted frequently, in fact, before any new combination is set up, so colors that will not give level dyeings are not used together.

We make use of the test in several different ways; first, as a method of control before setting up a new shade, when from a study of the exhaustion chart we select what we think are the most suitable colors for the combination. After the shade is matched and before it goes to the dye house, an exhaust is run upon the combination, for sometimes even though one thinks he has a suitable group of colors as rated on the chart, he finds that some irregularity occurs when they are combined. A second use for the test is to check already existing combinations. Very often a study of the exhaust on these combinations show where they can be improved, for it is surprising what such a test brings forth.

It is difficult to generalize upon the rating of various colors because their exhausts vary considerably, depending upon temperature and concentration, and to compromise with these conditions or to try to average them would be to give a false exhaust rating. This all the more emphasizes the point made at the beginning of this talk, and that is, it is most desirable for every plant to make a study of the colors they are using. Here is a general rating of the vat colors which we have studied according to shade, but since we cannot mention specific colors by name, we must warn you that this rating cannot be taken too literally, since especially among the yellows, oranges, violets, and olives, there are almost as many colors which will not follow the rule as there are colors that do follow. However, in general, we find these exhausts to be true.

Yellows:

Light and heavy shades, high temperature,
Medium or slow exhausting.
Light and heavy shades, low temperature;
Medium to fast exhausting.

Oranges:

Heavy shades; medium to slow exhausting, both low and high temperatures.
Light shades vary from fast to medium to slow, depending upon color.

Reds:

Medium to slow in both light and heavy shades and both low and high temperatures.

Violets:

Medium to slow in heavy shades;
Fast or medium in light shades, irrespective of temperature.
This group contains a number of exceptions to this rule.

Blues: "Thio-Indigoid Type"

Slow in heavy shades.
Medium or slow in light shades, irrespective of temperature.

Chlorine Fast Bright Blues:

Fast in light shades,
Medium in heavy shades, irrespective of temperature.

Navy Blues:

Medium at low temperatures in both light and heavy shades.
Medium slow at high temperatures, both light and heavy shades.

Greens:

Medium to fast, both light and heavy shades, high and low temperatures.

Browns:

In general, slow, both light and heavy shades, high and low temperatures.
Some browns, medium at low temperatures in light shades.

Olive Greens and Olives:

No standard types in this group.
Individual colors vary from fast to slow in light and heavy shades at high and low temperatures.

Greys and Blacks:

Fast in low concentrations;
Medium in heavy concentrations, irrespective of temperature.

Concentration of color probably does not actually change the rate at which a given color exhausts but due to the smaller amount in the dye bath, it may apparently dye on faster. For example, a commonly used violet at a 0.5 oz./gal. concentration is fast exhausting, both at 120° F., and 140° F., but at a 6.0 oz./gal. concentration, we rated its exhaustion at 120° F.—Medium to Slow, while at 140° F. it was rated Medium. We bring this point out because one can be mislead by running a set of exhaustion tests at one concentration and temperature. Were one to make one exhaust test on this color, at say 6.0 oz./gal. concentration at 120° F., and wished to use this color as a shading color along with a fast exhausting color, the dyer would probably discard it, but in a low concentration, this violet could be used quite satisfactorily. As another example, we have rated a black in a 6.0 oz./gal. concentration as a medium exhaust color, whereas at a 0.5 oz./gal. concentration, it is rated as fast exhausting. Flavone or Yellow G.C. at 140° F., in both a half and 6.0 oz./gal.

(Concluded on page P702)

Intersectional Contest—

The Prediction and Control of COLORED FIBER BLENDS By Optical Means

Presented by Dr. Seibert Q. Duntley for the Northern New England Section

IT will be the purpose of this paper to describe an objective optical method of predicting the quantities of constituent colored fibers required to produce a desired color after they are blended, and to suggest control procedures for use in the mill when the blending operation is undertaken.

From a color standpoint the blending of fibers can be considered an optical problem. The mass of fibers which constitute a dark colored blend have been found to behave optically in a very simple manner. The simplicity arises from the fact that the individual fibers are so deeply colored that impinging light traverses very few of them before it is extinguished by absorption. Almost the entire reflectance of the blend is obtained from the surface of the fibers lying near the top of the mass. Since the individual fibers are too small to be seen by the eye under normal inspection conditions, the observed color is an additive mixture of the light reflected by each of the constituent colored fibers. The effect is similar to that commonly observed on a stucco house. Here stones of various colors are mixed prior to application and are, therefore, randomly distributed over the surface of the structure. When viewed from a distance a stucco building appears to have a uniform color which arises from the additive mixture of light reflected from the various colored stones. In this case, the resultant color can easily be predicted if the color of the constituent stones is known together with the relative areas which they occupy. The same type of prediction may be made in the case of fiber blends.

The procedures about to be described have passed the laboratory development stage. They have been properly applied to full scale production problems; they have met the acid test of practice; they are now in daily use in at least one large woolen mill. The details of experimental technique depends upon the manufacturing problem at hand and upon the laboratory optical equipment available. We shall attempt in this paper to approach both the theory and the practice in general terms applicable and adaptable to a large number of circumstances.

At least two different kinds of problems come to the attention of the wool blender. One type of problem is represented by the need for dying several batches of loose top in such a fashion that when they are blended a color match will be secured to some originally accepted standard. The second type of problem arises when a mill has on hand substantial quantities of several different colored fibers which it wishes to blend in such a manner as to secure some desired color. When such a problem arises the colorist desires to know in what ratio the fibers must be blended in order to secure the match. The optical methods to be presented in this paper are capable of handling either type of problem. However, because of the limited time available only problems of the second type will be discussed.

Let us assume that two dark colored fibers, 1 and 2, are to be blended. Before blending, each is made into a pad by means of a small hand felting machine. The reflectance of each pad is then determined. In so doing, care must be taken that the measured reflectance is a true physical property of the fiber and does not involve the characteristics of the instrument with which the measurement is made. The simplest way of assuring this is to make the measurement with monochromatic light in such a manner that the result is expressed as the ratio of the reflectance of the fiber to that of a standard of reflectance such as magnesium oxide. Let the reflectance of fibers 1 and 2 be represented by R_1 and R_2; these quantities being understood to vary with wavelength. Let the fractional areas represented by the fibers be respectively a and b. If the fiber blend represents a true additive color mixture then the reflectance at any selected wavelength will be

$$R = aR_1 + bR_2 \qquad (1)$$

In practice we have found this to be an excellent approximation. It is evident that if the reflectance of the desired blend is known, a and b can be adjusted to yield the desired value provided that the reflectance of the blend R lies between the reflectances R_1 and R_2 of the constituents. The application at a single wavelength of an equation of this type offers a means of rapid control during the blending operation.

The experiments we have made to test the usefulness of equation 1 have been made with an automatic photoelectric spectrophotometer of the type described by Hardy. We believe this equipment to be necessary for the proper measurement of reflectance values under monochromatic light. The same equipment is ideal although not theoretically necessary to the more general methods about to be described.

Although the method suggested by equation 1 is ideal for control purposes it does not suffice for every problem confronting the colorist. For example, if he is faced with the problem of matching a customer's sample, he must be able to determine first, whether or not the constituent fibers available will match the color and, secondly, in what proportions they must be blended in order to secure a match. Both these problems find an easy answer in modern colorimetry.

Within the past two decades the science of colorimetry has experienced a great technological development. The language of colorimetry has been improved, and is internationally agreed upon. Both the illuminants and the characteristics of a normal human eye have been standardized by the International Commission on Illumination and ratified by 26 nations. The procedures by which colorimetry is carried out have been rendered rapid and automatic. Colorimetry stands today as a tool completed and ready for use wherever the measurement it yields is found to be useful.

Colorimetry of whatever sort consists in a statement that the color *looks like* a color produced in some controlled fashion by the colorimeter. In the system standardized by the International Commission on Illumination a color is measured by three numbers X, Y, Z, which represent the quantities of three standardized colored lights (primaries) which, if mixed, will match the color. Since the values X, Y, and Z represent quantities of radiation emitted each second by the primary lamps, they obey the same additive law as do reflection factors (equation 1). Thus, in a blend of two dark colored fibers, 1 and 2, the values of X, Y, and Z will be given by equation 2 provided the fiber blend represents a true additive color mixture.

$$X = aX_1 + bX_2$$
$$Y = aY_1 + bY_2$$
$$Z = aZ_1 + bZ_2$$

Technically the values X, Y, and Z are called tri-stimulus values, and they may be obtained very easily either by calculation from spectrophotometric curves, or from a direct reading trichromatic colorimeter. Of the several hundred makes of trichromatic colorimeters on the market not all yield results sufficiently valid for our purpose. The tristimulus values used by us have been obtained primarily from spectrophotometric data, although some tests have been conducted with a Hunter Multi-purpose Reflectometer equipped with the attachments intended to render it a trichromatic colorimeter.

Let X, Y, and Z be plotted as three dimensional Cartesian coordinates as shown in Figure 1. Sample 1 and 2 will then be represented by points in this space. By virtue of the additivity theorem (equations 2) all additive mixtures of colors 1 and 2 will lie on the straight line connecting them. By logical extension of this principle it is clear that any mixture of three colors represented by points 1, 2, 3 (Figure 2) must lie on the

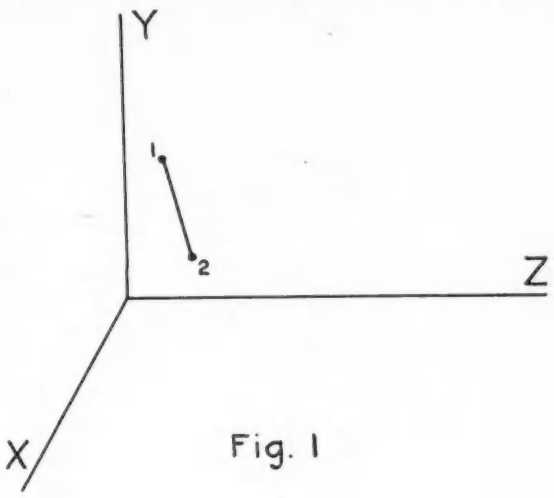


Fig. 1

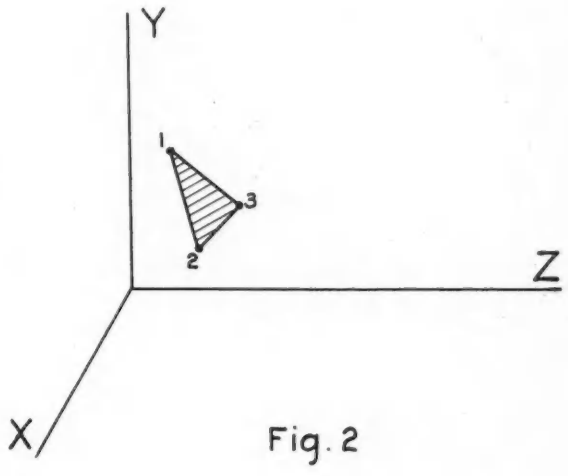


Fig. 2

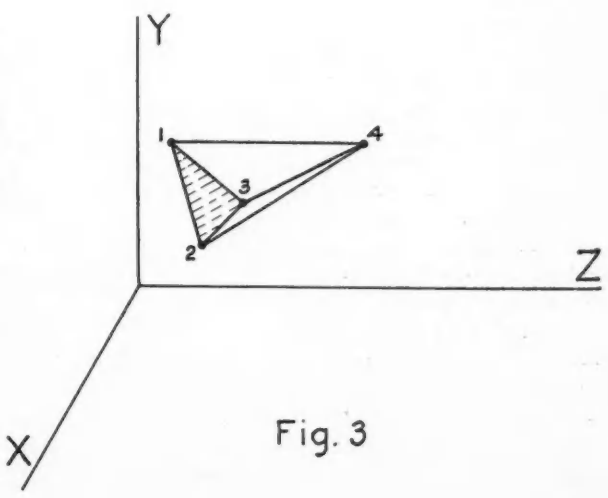


Fig. 3

plane triangle formed by the three points. It is also evident that all additive mixtures of four colors 1, 2, 3, and 4, (Figure 3) must lie within the tetrahedron having the four points as its apices.

Since we are dealing with a three dimensional color space, it is evident that, in general, it is necessary to blend four colored fibers in order to be able to match the desired sample. The coordinates X, Y, and Z of a blend of four fibers are given by equations 3 in which a represents the fractional area of fiber 1, b represents the fractional area of fiber 2, c represents the fractional area of fiber 3, and the quantity 1-(a + b + c) represents the fractional area of fiber 4. X, Y, and Z represent the coordinates of the sample to be matched.

$$X = aX_1 + bX_2 + cX_3 + [1 - (a + b + c)]\ X_4$$
$$Y = aY_1 + bY_2 + cY_3 + [1 - (a + b + c)]\ Y_4 \quad (3)$$
$$Z = aZ_1 + bZ_2 + cZ_3 + [1 - (a + b + c)]\ Z_4$$

Equations 3 can be re-written in the form of three simultaneous linear equations for a, b, and c, (Equations 4).

$$a(X_1—X_4) + b(X_2—X_4) + c(X_3—X_4) = (X—X_4)$$
$$a(Y_1—Y_4) + b(Y_2—Y_4) + c(Y_3—Y_4) = (Y—Y_4) \quad (4)$$
$$a(Z_1—Z_4) + b(Z_2—Z_4) + c(Z_3—Z_4) = (Z—Z_4)$$

From equations 4 a, b, c may be easily determined. The values of X, Y, and Z required for this purpose can be conveniently obtained by calculation from spectrophotometric data. In case a spectrophotometer is not available the readings of any valid trichromatic colorimeter will serve.

If it should chance that the desired color lies outside the volume of the tetrahedron in Figure 3, then it can not be obtained by blending the four fibers selected. This is immediately apparent from the solution of equations 4 because one or more of the fractional quantities will appear with a negative sign. This indicates that the desired color is unobtainable. Obviously, if the color is to be secured at least one additional fiber must be added to the blend. In most cases one of the others may be left out if desired. If more than four kinds of colored fibers are used, they can be thought of as blended in pairs until the total number of constituents in the blend has been reduced to four. The solution of equations 4 will then predict the ratios in which these primary blends must be combined in order to secure the desired color.

The optical procedures just described were based upon the assumption that all of the fibers in the blend are so dark that light penetrates through very few of them before being extinguished by absorption. If the blend contains light colored fibers the assumption is not justified and some modification of the experimental technique is necessary. An important practical example of a case of this sort is found in the army cloth now being produced in large quantities throughout the country. This is generally a blend of three dark colored fibers with undyed white fibers. If the previously described optical measurements are made upon the four constituent fibers and the result of the blending operation predicted by equations 3, large errors in prediction may be expected. Experience has shown that these errors arise entirely in evaluating the effect of the white fibers. However, the following simple experimental procedure has been found to satisfactorily eliminate the difficulty. Let a, b, and c represent the fractional quantities of colored fiber in the blend. Let a blend be made approximating the desired color. Measure the tristimulus values of the blended fibers together with the tristimulus values of the four components. Substitute these tristimulus values in equations 3. Substitute also the fractional amount of the three dark colored fibers a, b, and c. Solve these equations for d. Our experience has shown that the values ascertained will be about one-fifth the actual fractional quantity of white fiber in the blend. If the new value of d is used, subsequent predictions will be highly accurate.

In cases in which the fiber blend contains more than one light colored transparent fiber some more fundamental method is needed. Here we may adapt a suggestion originally made by Neugebauer in the field of three color printing by the half-tone process. Expressed in textile terms, Neugebauer's method consists of considering the color of a four-fiber blend as a fifteen component additive mixture consisting of light reflected after passage through but one of the component fibers, of light reflected after passage through two of the components in tandem, of light reflected after passage through three of the components in tandem, and of light reflected after passage through all four of the components in tandem. This obvious extension of the simple method described earlier in this paper may be considered as a second approximation required only in a few special cases. In retrospect then we have here a simple, practical, objective optical method for the prediction and the control of colored fiber blends. The method has been reduced to practice and is in daily use in the industry.

Defense Emergency—

(Concluded from page P695)

ing additional possibilities for defense purposes such as the use of pigments that are inert to infra-red photography, a feature of particular interest for camouflage work.

By proper coordination of procurement and supply so that full advantage can be taken of the vast resources of our great dye industry, we should be able to meet all defense requirements adequately.

CONCLUSION

In the brief moments allotted to us, we have endeavored to turn the spotlight on some of the methods and means by which chemists in the textile industry are endeavoring to carry on in the face of the present difficult situation.

We hope that here or there, somewhere in this paper, a word or suggestion may help some fellow-worker in the industry as he meets the problems of this great emergency.

ANNUAL BUSINESS MEETING
Friday Afternoon, October 31, 1941

THE Annual Business Meeting of the American Association of Textile Chemists and Colorists convened in the Grand Ballroom, The Carolina, Pinehurst, North Carolina, at 5:10 o'clock, Dr. Carl Z. Draves, President, presiding.

President Draves: We come to a regular and important annual event, the Annual Business Meeting. It used to be that at the Annual Business Meeting we announced the election of the new national officers, but under the Constitution that is no longer done. However, I do want to emphasize the fact about this Annual Meeting, that it represents in this, our American Association of Textile Chemists and Colorists, democratic government in operation. During ordinary times, throughout the year, the affairs of the society are administered through the national officers and the Council. The ordinary members are represented by these people; in other words, the Sectional Councilors and the National Officers represent their interests according to the principles of representative government. At this, the Annual Meeting, we give any member an opportunity to bring any proposition before the organization and the meeting is now open to anybody who wants to present any question he pleases. First, let us hear from our Secretary, Dr. Chapin.

Dr. Harold C. Chapin: The Constitution requires the Secretary to make an annual report of the activities of the Council during the year. These activities have been reported through the publications of various reports of Council meetings and need not be repeated here.

Our Association continues the uninterrupted growth of the past eight years, now numbering over 2,800 members. Noteworthy in the past year has been the addition of 12 new corporate members. Coming freely from the industry in response to a statement of our accomplishments, and to the efforts of a few members, this encourages the hope that through further effort we may acquire from the industry full financial support for the service we render it through the activities of our Research Committee.

President Draves: Are there any comments on the Secretary's report? May we hear from the Treasurer?

William R. Moorhouse: I am not going to give you any detailed report as that is published in the new Year Book that you have just received. The Treasurer's finances are in good shape. There is only one department, the Research Department, that has gone behind in the past year and probably what we need to do to bring that up is more corporate members. Thank you.

President Draves: Dr. Olney, have you anything to report for the Research Committee?

Dr. Olney: In the "Dyestuff Reporter" that appears this week (Oct. 27, 1941) you will find a detailed report in regard to the work of the Research Committee, which you may read at your leisure. I would like, however at this time to further emphasize what has been said upon other occasions regarding the financial support of the Research Committee. We have never made any attempt to secure a large number of corporate members. We have always felt that a slow growth was undoubtdely better than any extensive campaign to get additional corporate members. However, I do believe the Association has been in existence long enough by this time to have industry realize the value of our Association to them. We are really looking forward to a decided increase in corporate members during the coming year.

We published a special pamphlet which covers, in some detail, with particular emphasis on the Research Committee, the activities of the Association. We had quite a number of them brought down to this meeting and if any of you may be able to make use of more of them in securing any further corporate members we shall be more than delighted to have you take them and see if you can use them in securing a few more corporate members this coming year.

President Draves: Let me emphasize again that the work of your Council and your national officers is published at regular intervals in the "Dyestuff Reporter" and in the Year Book and anyone interested in any of the details can find them there.

If there is nothing new or old that anyone might care to bring before us, we stand adjourned.

. . . Whereupon the meeting adjourned at 5:30 o'clock . . .

MEETING, NORTH CAROLINA STATE COLLEGE STUDENT CHAPTER

THE North Carolina State College Chapter had its first meeting of the school year on November 5. The guest speakers for the morning and afternoon sessions were Nick Vieira and Paul Mitchell from the Charlotte office of du Pont's Fine Chemicals Division.

Mr. Vieira stressed the importance of students having a knowledge of the mechanics of dyeing and finishing equipment. Detailed blackboard diagrams were used to explain padding, mercerizing, singeing and continuous bleaching.

Mr. Mitchell explained the use of wetting agents, detergents, synthetic soaps, mildew proofing and synthetic resins. The properties and uses of resins as used in finishing were given.

Respectfully submitted,

GEORGE W. FUNDERBURK, JR., *Secretary*.

MEETING, PHILADELPHIA SECTION

THE Philadelphia Section inaugurated the current season program with a meeting at the Penn Athletic Club, Philadelphia, on Friday, October 24th.

Elmer C. Bertolet, our Section's Chairman Emeritus, and head of the Chemistry Department of the Philadelphia Textile School, in brief comments, directed attention to the fact that the school, the oldest textile school in the U. S. A., can now confer B.S. degrees in a variety of

subjects, including Chemistry, Dyeing and Printing, by authority of the Commonwealth of the State of Pennsylvania, issued through the Pennsylvania State Council of Education.

The Section's Councilors were directed to inform the National Council that the Section would be pleased to act as host to the 1942 Annual Convention.

The Nominating Committee, composed of Alban Eavenson, Chairman, Donald Powers and R. M. Ritter, recommended the following as nominees:

Arthur E. Jones, Chairman; James P. Conaway, Vice-Chairman; George E. Kohn, Treasurer; Boyce C. Bond, Secretary.

Councilors: Wm. A. Stringfellow, William Ebersold, John F. McCoy.

Sectional Committee: Glen S. Hiers, John A. Levering, Harold B. Dohner, Joseph Schmitz.

The technical program was an address on the subject of "Methods for the Evaluation of Textile Finishes" by E. C. Dreby, Ph.D. Dr. Dreby, as Research Associate of the American Society for Testing Materials, Committee D-13, with M. C. Moore, Ph.D., as Chairman, working at the National Bureau of Standards in Washington, did the major part of the research that resulted in the development of the Planoflex, the Friction-meter and the Compression Meter, instruments for the measurement of some of the physical properties of fibers and fabrics. Illustrating with slides, information obtained with the instruments, Dr. Dreby stressed the excellent agreement of instrument measurements with factual data obtained as a result of practical experience. Obviously, instrument measurements should be a more reliable means than tactual evaluation in respect to consistent reproducibility and to detect minor differences. Dr. Dreby exhibited the three instruments he used for his work and explained their construction and illustrated their use. A report of his work is scheduled for publication in an early future issue of the AMERICAN DYESTUFF REPORTER.

Dr. Dreby is now a member of the Scholler Brothers, Inc., Philadelphia, technical research staff.

Attendance at the dinner—78; at the technical session—94.

Respectfully submitted,

CHARLES A. SEIBERT, *Secretary, Pro Tempore.*

Vat Colors—

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concentration, we rate as slow, whereas at 120° F., this color is rated medium to fast, a wide difference. This is an example where a decrease in temperature actually increases the speed of exhaust.

Among the blues, we find that an increase in temperature from 120° F., to 140° F., with the exception of Thioindigoids, increases the speed of exhaust. A bright greenish blue of the Chlorine Fast type is rated as medium at 120° F., but picks up to medium fast at 140° F.

Therefore, one has the problem of not only considering the concentration of color in order to determine its use in a combination but must also consider the most suitable dyeing temperature for the combination, since we have colors that contradict each other and speed up their dyeing rate if the temperature is dropped as against other colors that speed up their dyeing rate if the temperature is raised.

All this may sound quite complicated, but in reality observations made on exhausts are easily kept in mind when one is working with a particular group of colors. Also, we should not forget that the true answer as to how a combination is going to dye is to exhaust that particular combination, not the individual colors. The only help exhausts on individual colors at various concentrations and temperatures can be, is to prevent the dyer before matching a shade, wasting a lot of time on a combination of colors that will not prove eventually satisfactory.

An interesting result of this study of exhaustion rates has brought about a change in the temperatures at which certain combinations are dyed. To some extent, our dyeing temperatures have been regulated by whether or not a color was described to us by the dyestuff company as a hot, medium or cold dyeing color and we usually dyed a combination at the recommended dyeing temperature of the base color in the shade. We do not follow these recommendations too closely at the present time, but dye a combination at whatever temperature it exhausts the most level. This may not be according to rule, but we do know we have eliminated taper and bad ends by a change of 10 or 20 degrees in the dyeing temperature of a combination.

In selecting colors for a shade, according to exhaustion rates, let us assume we are going to run a group of three colors. Naturally, the ideal combination would be to have colors of the same rate of exhaust, either all fast, medium or slow. The next best would be to have two colors in the combination of the same rate of exhaust, with the third as close as possible. Less attractive, but still a combination that will run well is to have the base color of one rate of exhaust, and the two shading colors of a rate of exhaust close to that of the base color. Still a fourth possibility, though not as satisfactory as the first three is to have the base color one rate of exhaustion, the main shading color a second and the minor shading color a third. This does not work too badly where the two shading colors are used in proportions of 20.0 per cent or less of the base color. Where one is using colors in approximately equal proportions, beware of colors of different rate of exhaustion. These rules also hold true if four or more colors are employed in making a combination. In two color combinations, it is absolutely essential that the rates of exhaust be as nearly the same as possible, for colors of widely different rates will not run well together.

We trust this paper has been of interest to those engaged in actual dyeing operations, and we can assure you that in our experience the investigation of exhaust rates has proven both practical and profitable.

TRADE NOTES • NEW PRODUCTS

• ANNUAL MEETING, T.R.I.

The annual meeting of the Textile Research Institute, Inc., was held on November 14th at the Roosevelt Hotel in New York City. A director's meeting was held in the morning followed by the meeting of members.

A large number of guests joined with the Institute at a luncheon session. At this time Fessenden S. Blanchard, president, discussed the future of the Institute. In discussing the program of research he indicated that three major purposes have been planned: (1) bringing to the mills the results of fundamental and applied research being conducted by the Institute, the Textile Foundation and others; (2) aiding members in their research activities and guiding research projects which are being undertaken under the auspices of the Institute; (3) bringing to the laboratories a clearer understanding of the practical problems in which the mills are most interested. The work of the Institute is to be divided into three main functions: (1) scientific and industrial research, as outlined above, under the direction of Dr. Milton Harris; (2) publications, publicity and information under a man to be selected; (3) economic research, temporarily under Stanley Hunt, as chairman of the committee. Dr. Harris spoke on the research program; Rear Admiral H. G. Bowen, technical aide to Secretary of the Navy Knox and director of the naval research laboratories spoke on the research work of the navy; and Westbrook Steele, executive director of the Institute of Paper Chemistry at Appleton, Wisconsin, spoke on the organization and accomplishments of that Institute.

• NYLON EXPANSION

The du Pont Company announced on November 27th that a further 25 per cent expansion of its nylon yarn capacity to 20,000,000 pounds yearly, at normal deniers, has been authorized.

The newest expansion will be effected by adding 50 per cent to the present yarn-producing capacity at Seaford, Delaware, and by rounding out facilities at Belle, West Virginia, for the manufacture of nylon intermediates.

It was said that the engineering design work has been largely completed. Actual ordering of materials and installation of new facilities will "proceed as rapidly as conditions of procurement permit."

Engineers estimated that the earliest possible date that the facilities would become available for yarn production is "the late fall or end of 1942."

Since announcement late in 1938 of nylon's discovery by du Pont research chemists, its manufacturing history has been one of unprecedented expansion. The original plant at Seaford was scheduled to have a capacity of 3,000,000 pounds yearly. In less than one year, this was increased to an authorized 8,000,000 pounds.

A second plant doubling the Seaford output was begun at Martinsville, Virginia, in October 1940. Preliminary operations there were started a few weeks ago and this plant is expected to attain capacity production next summer.

• SYNTHETIC PINE OIL

A new process for the synthetic production of pine oil from gum turpentine which makes it possible for the naval stores industry to meet current demands of the national defense program for this material is announced by Hercules Powder Company.

The process developed by the company produces synthetic pine oil said to be of substantially the same chemical and physical properties as natural pine oil. It may be described chemically as a well-defined mixture of terpenes and secondary and tertiary alcohols having a mild aromatic pine aroma.

It is claimed that laboratory and plant tests indicate the new pine oil is suitable for all of the important uses for which pine oil is now employed. Included in these are textile wet finishing, paint and varnish manufacture, paper coating, essential oils, industrial and commercial laundering, disinfectants, liquid scrub soaps, industrial cleansers, cattle sprays, rag boiling, leather processing, flotation reagents in mining metals, metal polishes, liquid hand soaps, pine scented bar soaps, and solvent for synthetic resins.

Pine oil is now required in great quantities for the separation of metals from their ores. Defense demands for zinc, lead, copper, and molybdenum have greatly increased consumption.

At the same time, the use of pine oil in the manufacture of woolen clothing for the army and navy is said to have greatly increased the pine oil requirements of American industry. In textile manufacture, pine oil may be used for scouring and cleansing wool, and for fulling.

Pine oil is derived naturally in the wood naval stores industry which extracts turpentine, pine oil, and rosin from the stumps of pine trees left after lumbering operations. The gum process, by which naval stores products are obtained by tapping trees and distilling the gum or sap thus obtained, produces no pine oil. Production of synthetic pine oil from gum turpentine thus opens up a new source of supply.

"The major influence on the price of the new oil will be the price of gum turpentine," the company said. "Because of current relatively high prices for gum turpentine, the price of the new oil will be considerably higher than that of natural pine oil. The new process, however, will assure an increased supply of pine oil for defense industries and possibly make available some supplies for non-defense uses."

• BORNE SCRYMSER BOOKLET

A new 22-page booklet titled "Using the Rainbow," which describes in considerable detail the fugitive tints marketed by Borne Scrymser Company in connection with their tintinol process for fiber identification, has recently been issued. There are many photographs and color illustrations supporting the subject matter and it is presented in such form as to be of interest, and as a reference, to all those engaged in research as well as production of natural and synthetic textile fibers.

Copies may be obtained by writing to the general offices of the company at Elizabeth, New Jersey.

• GENERAL RELEASES

General Dyestuff Corp., 435 Hudson Street, New York City, has released circulars describing the following products:—

Methylene Violet 3RA Extra—a basic violet of bright, reddish shade. It is said to be well suited for dyeing mordanted cotton or rayon, silk, and other fibers when brightness of shade is the principal requirement. Due to its good resistance to Rongalite, it can also be used for colored discharge printing. Circular G-297.

Rapid Fast Yellow GGH Powder—a new addition to the General line of Rapid Fast Colors. When printed according to the usual neutral steaming method for Rapid Fast types, it yields bright, fairly greenish shades of yellow said to possess good fastness to light and to chlorine and very good fastness to washing. It is stated that since, when dissolved with caustic soda in the usual manner, it can be developed in either acid or neutral steam, it can be printed alongside the ordinary acid developing Rapidogens as well as alongside vat colors and the neutral developing Rapidogens prepared with Developer RPN. In addition, when dissolved with Developer RPN instead of caustic soda, it can be combined with the neutral developing Rapidogens. Circular G-300.

Benzo Chrome Brown BA — a direct color well suited for producing chocolate brown shades on the various forms of cotton or rayon. It is also of value as a base for union dyeings. It is stated that aftertreatment with bichrome and acetic

acid turns the shade somewhat yellower and improves the fastness to washing. Circular G-301.

• NATIONAL ANILINE DIVISION

National Aniline & Chemical Company, Inc., a subsidiary of Allied Chemical & Dye Corporation, is being merged with the parent company and its business will be conducted as the National Aniline Division of Allied Chemical & Dye Corporation.

B. A. Ludwig, President of National Aniline & Chemical Company, Inc., has been appointed Vice-President of Allied Chemical & Dye Corporation.

• JOINS HART PRODUCTS

Frank Greenspan, Chemist, has joined the staff of the Hart Products Corp., offices at 1440 Broadway, New York City and works and laboratories at Woodbridge, New Jersey. He has a B.S. in chemistry, College of the City of New York, and an M.S. in chemistry, Polytechnic Institute of Brooklyn, N. Y. For 4 years he was chemist in charge of the Textile Laboratory for Lane Bryant, Inc., New York. He is known for his work on evaluation of textiles, textile finishes and dyes; and has done research on textile analysis and on gas fading of acetate rayon colors.

• DCAT SECTION, ANNUAL MEETING

The Drug, Chemical and Allied Trades Section of the New York Board of Trade held its 51st Annual Meeting and Election at the Drug and Chemical Club, 85 John Street, on November 18, with approximately 125 executives present. John J. Toohy, Chairman of the Section and Distribution Manager for E. R. Squibb & Sons, was toastmaster at the meeting featured by the address of David Sherman Green, former Economic Advisor to Siam, who spoke on the subject "Thailand Today."

The various officers of the Section including the Chairman; Robert B. Magnus, Treasurer; Carl M. Anderson, Counsel; and John C. Ostrom, Secretary; reported on the work of the Section during the past year, particular emphasis being placed on the individual services rendered members in the daily transactions of their business. E. T. T. Williams, Chairman of the Membership Committee, reported a total of 31 new members for the year stating that the roster now includes some 329 member firms.

There are listed below the names of the individuals elected to the Executive Committee for the coming year, from which will be elected at its first meeting, the officers of the Section to serve for the ensuing fiscal year:

Carl M. Anderson, Merck & Co., Inc.; Harold M. Altshul, Ketchum & Company; C. C. Caruso, Schieffelin & Company; James J. Clark, Liggett Drug Company; Hugh Crosson, McKesson & Robbins, Inc.; James DeCesare, White Laboratories, Inc.; William W. Huisking, Chas. L. Huisking & Co.; J. H. Karrh, Victor Chemical Works; Elvin H. Killheffer, E. I. du Pont de Nemours & Co.; Paige D. L'Hommedieu, Johnson & Johnson; Robert B. Magnus, Magnus, Mabee & Reynard, Inc.; Guy L. Marsters, Norwich Pharmacal Company; S. B. Penick, Jr., S. B. Penick & Company; Robert J. Quinn, Mathieson Alkali Works; J. P. Remensnyder, Heyden Chemical Works; Carroll Dunham Smith, Carroll Dunham Smith Pharmacal Co.; Ira Vandewater, R. W. Greeff & Company; Lloyd I. Volckening, Ivers-Lee Company; E. T. T. Williams, Becton, Dickinson & Company, and Victor E. Williams, Monsanto Chemical Company.

Francis J. McDonough, President of the New York Quinine & Chemical Works, was re-elected the Section's Representative on the Board of Directors of the New York Board of Trade.

OPEN FORUM

56—While text book information is available regarding the process of chlorinating wool, it has been found that this is somewhat contradictory and does not always work out satisfactorily in practice. We should be pleased to have a definite procedure for chlorinating wool fabrics both in the form of woven cloth and knit goods that has been satisfactorily used; also, the type of apparatus which is best suited for the purpose.—**R. O. B.**

57—Some years ago, a paper was presented at an annual meeting of the A.A.T.C.C. concerning the effect of heat, as to absorption by fabric, in dyeing, printing and finishing. Inquirer would be interested to have from the author of this paper, or others, any comments relative to the subject, bearing on the theory advanced that level dyeing, and printing, depend primarily upon the uniformity of the heat applied during preliminary processing, especially as concerns singeing.—**T. T. J.**

BOOK REVIEW

The Federal Wage and Hour Law *(The Fair Labor Standards Act of* 1938*), Questions and Answers. A Manual for Executives, Department Heads and Supervisors. By Arthur W. Nevins. National Foremen's Institute, Inc., Deep River, Conn. Price* $1.50. *58 pages.*

This handbook contains up to the minute rulings pertaining to the wages and hours law, and answers questions with which all types of executives and business men may be faced. The book consists largely of a series of questions and answers. The answers are made specially plain through the citation of definite cases which might arise.

• CLASSIFIED •

WANTED: Manufacturing Chemist, excellent opportunity, to take charge of production and laboratory. Broad experience in textile scouring, dyeing and finishing compounds—including gums, starches, resins, pigments, soaps, etc. Jersey City vicinity. Write Box No. 349, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Hosiery dyer for past sixteen years on pure silk, cotton, rayon, nylon and mixed fibers, with large hosiery mill in south as head dyer. Capable of handling large production, willing to go anywhere, best reference. Member of American Association of Textile Chemists and Colorists. Write Box No. 355, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED: LABORATORY MAN—Experienced in testing dyestuffs and textile chemicals. Permanent position in Middle West. Give complete details of past experience and state salary desired. Write Box No. 356, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED: Chemist—to take charge of laboratory in rayon dyehouse. Man with experience and practical knowledge of dyehouse problems preferred. State age, experience, and salary desired. Write Box No. 357, American Dystuff Reporter, 440 Fourth Ave., New York, N. Y.